WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

NOVEMBER, 1951

Pollution Reduction Progress at Waynesboro, Va.

One picture can be worth a thousand words

The Choice of Five Capitals

WASHINGTON, D.C. • U.S.A.

WASHINGTON, D. C. • RIO DE JANEIRO
BOGOTA • CARACAS • CIUDAD TRUJILLO

Five capital cities under five different flags, but with one important factor in common . . . they all have major water supply lines built of Lock Joint Concrete Pressure Pipe.

• • •

This unanimity of choice can be attributed to the sound design, high quality of materials and excellent workmanship which goes into the production of Lock Joint Concrete Pressure Pipe. The ample steel reinforcing provides a rugged pipe which will withstand both high internal pressures and unusually heavy overburdens. Walls of carefully proportioned concrete prevent corrosion or tuberculation assuring durability and permanently high carrying capacity. Flexible expansion joints at every joint provide easy installation and assure permanent water tightness under all conditions of service.

• • •

The test of time has proven Lock Joint Concrete Pressure Pipe lines to be extremely economical to operate, requiring practically no maintenance or repairs throughout an estimated useful life of more than 100 years. Yet the pipe is amazingly low in initial cost.

• • •

For your next water transmission line involving pipe 16" in diameter or larger, specify Lock Joint, the capital pipe chosen by capital cities because of its durability, dependability and economy.

BOGOTA • COLOMBIA

CARACAS • VENEZUELA

CIUDAD TRUJILLO
DOMINICAN REPUBLIC

RIO DE JANEIRO
BRAZIL

SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply Distribution Mains in a wide range of diameters as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.

LOCK JOINT PIPE COMPANY
Est. 1905
P. O. Box 269, East Orange, N. J.
PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich.
BRANCH OFFICES: Casper, Wyo. • Cheyenne, Wyo. • Denver, Col. • Kansas City, Mo. • Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. Kenilworth, N. J. • Hartford, Conn. • Tucumcari, N. Mex. • Oklahoma City, Okla. • Tulsa, Okla. • Beloit, Wis. • Hato Rey, P. R.

COLD FACTS ON A HOT SUBJECT

METER MANUFACTURER USES EVERY MODERN TECHNIQUE TO POUR FINEST BRONZE CASTINGS

Pouring small meter bodies in the Rockwell foundry

The quality built into every Rockwell water meter is quickly apparent by examining the outside case. You won't find any pin holes, flaws or burnished areas on the smoothly grained surface of a Rockwell casting. That's because these castings are poured in Rockwell's own modern, completely mechanized foundry under close laboratory control.

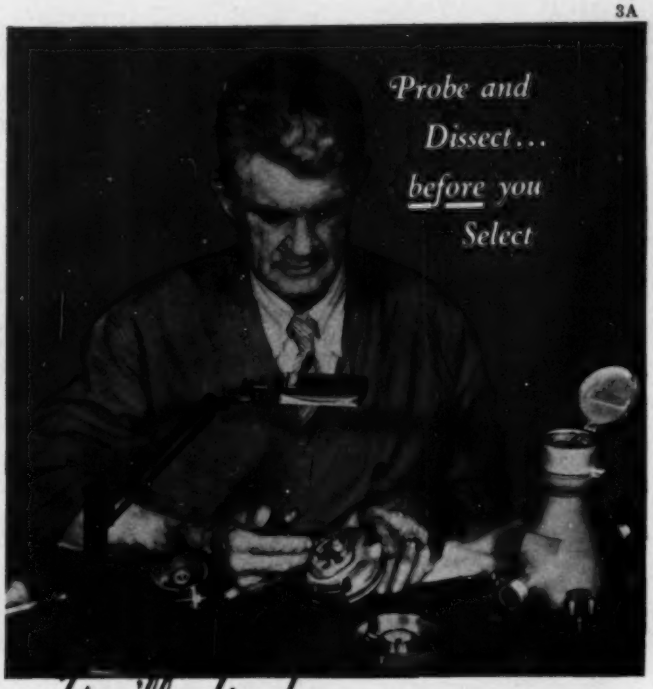
Real Alloy Bronze

Rockwell meter castings are made of real alloy bronze. No skimping on materials is permitted. Every casting must be made to the full 85-5-5-5 composition that is recommended for use in most meters. This material is made up of 85 per cent copper, 5 per cent tin, 5 per cent zinc and 5 per cent lead. But it takes more than fine materials to make a fine casting. It takes excellent foundry equipment, close laboratory supervision and foundry "know how"—all of which Rockwell has to a marked degree.

Green sand molds are made in multiples on a precision molding machine—cores are produced in a core blowing machine, then baked in a large temperature controlled gas fired oven. Crucible type melting furnaces reduce the metal. Every precaution is taken to make sure it is kept free from impurities. Finally the molten bronze is poured into the completed molds at prescribed temperatures that are carefully controlled by instruments.

Comparison Proves

You can actually see and feel the difference in Rockwell meter castings. And this superiority carries all the way through the meter manufacturing process, right down to the final testing. Full size, full weight, full copper content meter castings are just an exterior indication of the better values built into all Rockwell water meters.



You'll find EVERY WANTED FEATURE IN EMPIRE METERS

What do you want of a meter... long life... repair ease and economy... sustained accuracy? Whatever your wants, we have wrapped them up for you in the Rockwell-Empire. Just examine this design. First you'll notice the Empire oscillating piston, performance proved in service since 1884 to provide maximum accuracy in measurement with minimum wear. Next you'll find the convenient arrangement of internal parts. Everything goes together like hand in glove. It was designed to save you money in maintenance. Consider too, the balance of this assembly with everything working in planes or perpendiculars. This construction offers less friction and provides more sensitivity to low flows and a longer meter life.

Now is the time to investigate metering the Empire way. Learn how to get *lasting accuracy* for the *longest life* at *lowest cost*. Ask your Rockwell representative for an eye-opening demonstration.

POSITIVE, LOW COST CONTROL OF INDUSTRIAL WASTES...

Effective, positive treatment for phenol, cyanide and other noxious industrial wastes—without excessive installation and operating costs—is now available through the Mathieson Chlorine Dioxide Process. Existing installations, handling both large and small waste volumes, attest to the efficiency and economy of this treating method.

Mathieson's Chlorine Dioxide Process

* Low Capital Investment

A Chlorine Dioxide system to handle an average waste output can be installed for $2000-$3000, and amortization charges are negligible. The equipment consists only of a small holding tank, a chlorine dioxide solution generator and the metering equipment for the chlorine and sodium chlorite solutions.

* Simple Installation

The Chlorine Dioxide system, being extremely compact, can be quickly and easily fitted into the disposal facilities. No special housing is necessary to contain the equipment.

* Minimum Maintenance

The simplicity of the Mathieson Chlorine Dioxide equipment minimizes maintenance and no special technical supervision is required for operation. The chlorine dioxide is fed automatically at the pre-determined rate for safe, positive control.

Mathieson's background of experience, accumulated over many years in the field of sanitation is available to you. Write for information about the Chlorine Dioxide Process. Mathieson Chemical Corporation, Baltimore 3, Maryland.

Mathieson CHEMICALS

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH

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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

COMING ARTICLES

"Developments and Trends in Water Supply, Sewage and Industrial Waste Treatment" will, as customary, be reviewed in our January and February issues. Water Supply Developments will be reviewed by A. E. Berry, Pres., AWWA. Sewage and Industrial Waste Treatment by Earnest Boyce, Pres., F.S.&I.W.A. . . . "Deep Well Maintenance" will be discussed by J. B. Murphy of Am. W.W. Service Co., . . . "Water Softening Improvements at Cedar Rapids" comes from F. E. Grundler . . . "Experiences in Main Cutting" are set forth by Dan Anglin, Distr. Supt. at Chicago . . . "A New Coagulation Aid" will be introduced to the field by Steeper & Dickerson of Hercules Powder Co. and Kemmer & Houser of Cochrane Corp. . . . "Water Treating Experiences" by Albert Ullrich

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MUELLER

Quality

THROUGH AND THROUGH

CURB STOPS

- Two patterns to choose from . . . inverted key and conventional, complete selection of types and styles.
- Quality materials . . . high copper bearing bronze for long-time corrosion resistance.
- Precision ground key and body for perfect fit . . . assures water tightness.
- Accurately aligned and machined threads run up smoothly, seal tightly.

CORPORATION STOPS

- Designed for installation on dry or pressure mains with Mueller Tapping Machines.
- Wide selection of types for steel, cast or wood mains, with a variety of outlets.
- High copper content bronze for corrosion resistance.
- Precision machined threads provide tight seal.

■ QUALITY design, manufacture and materials show up *right away* . . . and *over the years,* too, when Mueller Curb and Corporation Stops are on your installation. Right off, you'll see how they fit . . . make a positive, pressure-tight seal. That's QUALITY! Bury a Mueller Stop and forget about replacements for generations. That speaks for Mueller QUALITY, too! Specify Mueller connections and equipment. Contact your Mueller representative, or write for Catalog H.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

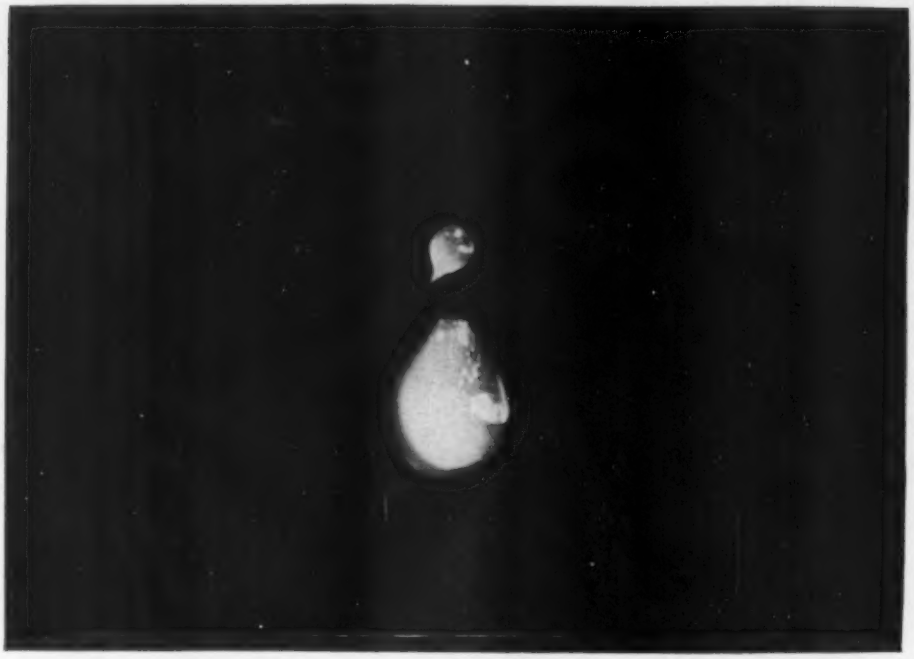
Mobile's City Hall, a fine example of French colonial architecture, as it looked 100 years ago

The City of Mobile in Alabama has been under four flags since it was founded in 1702 as the capitol of the French province of Louisiana. As one of our older cities, Mobile quite naturally has cast iron water and gas mains in service that were laid well over a century ago. Thanks to the shock-strength, crushing-strength and beam-strength of cast iron pipe, these old mains continue to cope with stresses undreamed-of when they were installed. And because of these strength-factors of long life cast iron water and gas mains, laid over a century ago, are still serving in the streets of more than 30 American cities.

United States Pipe and Foundry Company, General Offices, Burlington, N. J. Plants and Sales Offices Throughout the U. S. A.

U.S. PIPE

NUMBER ELEVEN OF A SERIES



What Price . . . A Drop of Acid?

The price of a drop of acid is mighty small as long as you keep it in a carboy. But let it out — give it half a chance to get to your equipment — and it really can get expensive.

In water treatment and sewage disposal plants, particularly, chemical attack is a major problem — one that can cost plenty in "down time" and equipment replacement — one that can cause no end of headaches. But you can stop your troubles before they start — keep the cost of chemical fumes and spillage 'way down — with TYGON "Series TP" PAINT. Virtually all acids, alkalies, oils, and waters roll off a TYGON painted surface "like water off a duck's back".

Here's just some water and sewage treatment equipment that can benefit from the protection of TYGON PAINT: Mixing and storage tanks, chemical feeders, bins, hoppers, conveyors, grinders, digester covers, sludge scraper and skimmer arms, rotary distributors, filters, pumps, motors, and piping. TYGON also does an excellent job of protecting structural steel, walls, and ceilings from chemical attack.

And, here are some of the "treating" chemicals that are "stopped" by TYGON: Lime, alum, ferric chloride, sodium silicate, chlorine hypochlorite, copper sulfate, activated carbon, soda ash, ammonia, carbon dioxide, hydrogen sulfide, oils, greases and miscellaneous acids.

TYGON PAINT is available in a wide range of colors. It requires no more surface preparation than that of good commercial practice. It is easily applied by brushing or spraying. Its dry film is smooth and practically impermeable. It's tough, flexible, non-aging, non-flammable and easy to clean.

Make your first line of defense against chemical attack a good, thoroughly protective coating! Make it TYGON PAINT!

Don't delay, write, today, for full details and technical data. Just ask for Bulletin 720.

Address: The U. S. Stoneware Co., Akron 9, Ohio
Plastics and
Synthetics
Division

247C

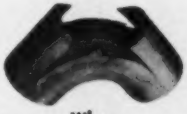
To Control Leakage these Pontoon Tide Gates use BYERS WROUGHT IRON PLATES

An interesting solution to leakage control into intercepting sewers is found in the new pontoon tide gates used at Owl's Head Sewage Treatment Works. These gates were developed by the Krajewski-Pesant Manufacturing Company and approved by the City of New York, Department of Public Works. Installed at points where the sewers empty into the harbor, the gates open when the sewage flow is above normal, as it might be during a storm. At other times, the gates are closed, preventing back-flow from the tidal basins. Containing 14 watertight compartments, continuously welded, the gates have sufficient buoyancy to permit opening under a 2-inch differential head. This "floating" feature prevents excessive backing-up of flow in the sewer system.

These gates face a double hazard, as both the sewage and the brackish and salt water are highly corrosive. To combat this condition, the contractors selected genuine wrought iron in place of the low-first-cost material, which had been originally specified. This choice was approved by the City's engineers. One of the six gates, all of which used wrought iron flaps, is shown above.

Our bulletin, WROUGHT IRON FOR SEWAGE TREATMENT AND DISPOSAL INSTALLATIONS, gives a concise but comprehensive story of how wrought iron is reducing maintenance in dozens of services. We'll be glad to send you a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.



Why Genuine Wrought Iron Lasts

This notch fracture test specimen illustrates the unique fibrous structure of genuine wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

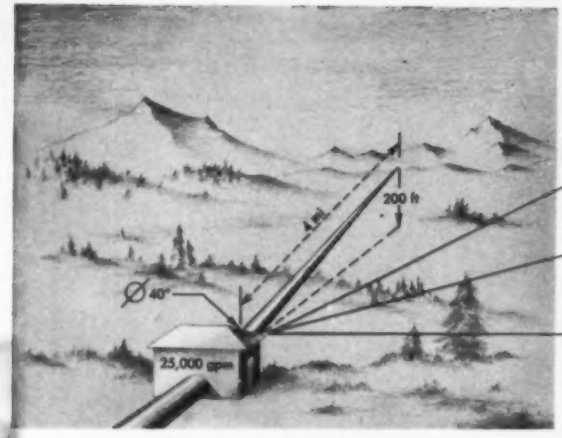
BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



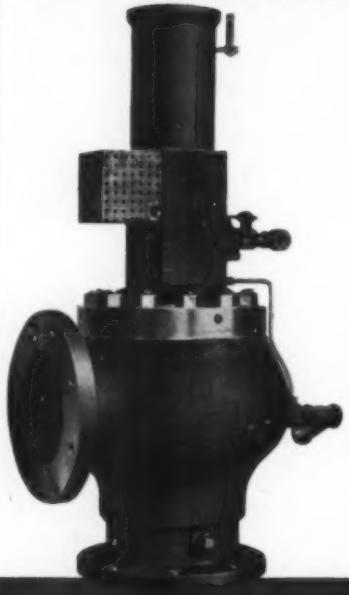
250 feet of head

525 feet of head

975 feet of head

?

CAN YOU PICK THE CORRECT ANSWER?



Here is the problem: Estimate how high total pressure head could rise from surge if power failure brought the pump in this system to an abrupt stop.

25,000 gallons per minute are being pumped up an elevation of 200 feet in a total pipeline length of 4 miles. Pumping head is 250 feet. Pipe diameter is 40 inches. A check valve is used to stop backflow through the pump.

Make your guess, then here is the answer

Total pressure head could rise as high as 975 feet. Inertia of the upward moving column of water builds up great potential energy. As the water settles back against the check valve, a succession of dangerous pressure waves occurs, often sufficient to burst the pipeline.

THE PELTON SURGE SUPPRESSOR

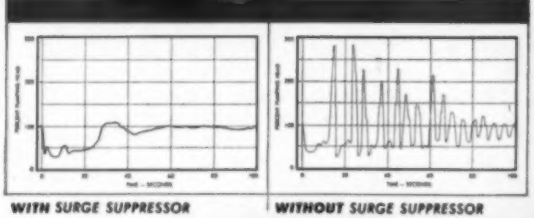
affords positive protection against this ever present danger — protection that no other valve gives.

Either current stoppage or pressure build-up actuates the **PELTON** Surge Suppressor. This quick-opening valve anticipates return surges and dissipates them by by-passing water around the pump; then it slowly closes as the pressure waves cease.

Lower pipeline costs can more than pay for a **PELTON** Surge Suppressor. Extra weight is eliminated because the pipe need not be designed with large safety factors in anticipation of high surge pressures. The possibility of line failures and interrupted service is greatly decreased.

Installations needing protection occur wherever water is pumped to a higher elevation either through a long pipeline or at high velocity. **PELTON** Surge Suppressors can be furnished to protect waterlines of any size handling service pressures up to 800 p.s.i.

Send us your problem and include pipeline profile. Our engineers will make recommendations without obligation.



WITH SURGE SUPPRESSOR ***WITHOUT SURGE SUPPRESSOR***

The PELTON WATER WHEEL Company

Subsidiary of Baldwin-Lima-Hamilton Corporation

2929 NINETEENTH STREET • SAN FRANCISCO 10, CALIFORNIA

BALDWIN BLH LIMA-HAMILTON

Streamway POWER FOR PUMPS

WITH THE NEW VERTICLOSED

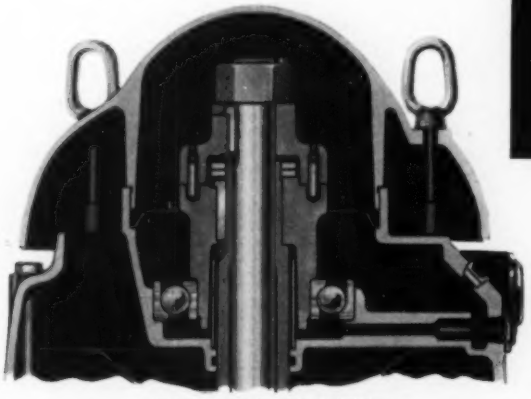
U. S. MOTOR

This amazing new motor involves much more than attractive external appearance. It introduces an entirely new conception of pump motor refinements. The deep well pump you select and its U. S. Verticlosed Motor become fully integrated both in structure and function.

The Verticlosed Motor is the progressive result of designing a motive unit for a specific purpose—to *most economically* power a deep well turbine pump.

You can order this new motor as an integral part of your new pump without paying increased price. Or you can replace your present pump motor without paying for expensive fittings.

Whatever pump you choose, specify the U. S. Verticlosed Motor. You'll save on power; you'll benefit by real economy through many years of extra pump life.



Detail showing Reg-U-Lube Oil Flow

Improved lubrication with

REG-U-LUBE and LUBRIFLUSH systems

Because pump motors must continuously operate for long periods under heavy load, lubrication must be positive—never failing. In the larger size Verticlosed Motors the proven Reg-U-Lube system provides a gravity-fed oil flow which keeps bearing lubricant at normal temperature. In Verticlosed Motors of under 25 h.p., 1800 rpm, the perfected Lubriflush system permits thorough flushing of old devitalized grease.

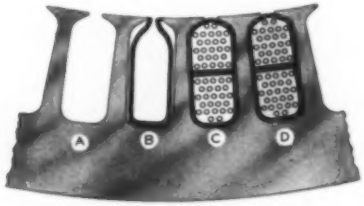
AMERICA'S MOST DYNAMIC PUMP MOTOR

(See next page)

THESE ADVANCED U. S. MOTOR FEATURES INCREASE THE LIFE AND SERVICE OF DEEP WELL PUMPS

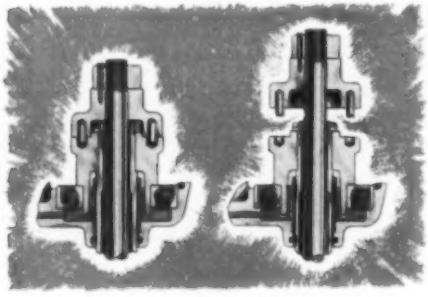
To give the maximum service, a deep well turbine pump must be powered by a motor free from vibration, free from excessive bearing stresses, ever-cool during long periods of continuous operation, and high in efficiency. The new U. S. Verticlosed Motor meets and exceeds these requirements. Moreover it offers many advanced features found in no other motor because it has been designed for one specific service—the powering of deep well turbine pumps. More than forty years of constant progress are reflected in its incomparable design.

U. S. Vis-O-Lube Oil Gauge



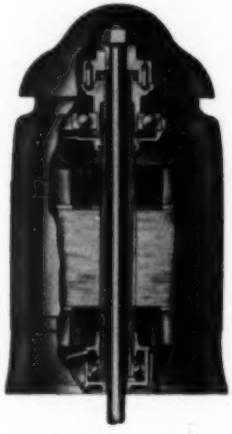
ASBESTOS-PROTECTED WINDINGS

Asbestos *cannot* carbonize. It safeguards U. S. motor windings from internal heat. The above drawing shows method of application. *(A)* Empty stator slot. *(B)* Insulating sheet asbestos. *(C)* Conducting wires in asbestos cell. *(D)* Complete asbestos impregnation around each wire.



REVERSE PROTECTION CLUTCH

By using the famous U. S. hollowshaft, the pump shaft is connected with the motor shaft through this reverse protection clutch. The pump shaft cannot become unscrewed by torque reversal.



Showing the hollowshaft principle conceived and patented by U. S. Motors. The flexible coupling is eliminated, and pump head thrust bearings relocated in the motor.

FULLY VISIBLE OIL GAUGES

No more unsightly, protruding oil gauges. The new U. S. Vis-O-Lube gauges are set within the motor, fully visible at a distance. Large, clear Lucite windows reveal oil content.

NORMALIZED CASTINGS

Fine precision parts such as used in giant telescopes, artillery guns, angle blocks, etc., are invariably *normalized*, to prevent warpage and stresses. So are U. S. motor castings; therefore bearings are always in perfect alignment, insuring longest life.

Whatever the pump, make U. S. Motor a "must"

The leading deep well turbine pump manufacturers of America long ago accepted U. S. Motors as the most outstanding and dependable power for this specific service. Many pump builders have designed their pumps to synchronize with the streamlined beauty of the new and improved U. S. Verticlosed Motor. Be sure you get a U. S. Motor. Accept no substitute.

Write today for descriptive, illustrated Bulletin

The QUALITY LINE of Power

ELECTRIC MOTORS TO FIT THE NEED

VARIDRIVE — SYNCROGEAR — VERTICLOSED — UNICLOSED— UNIMOUNT AND TOTALLY-ENCLOSED

Request Bulletin featuring any of these motors

U.S. ELECTRICAL MOTORS Inc.

PACIFIC PLANT: Los Angeles 54, Calif. • ATLANTIC PLANT: Milford, Conn.

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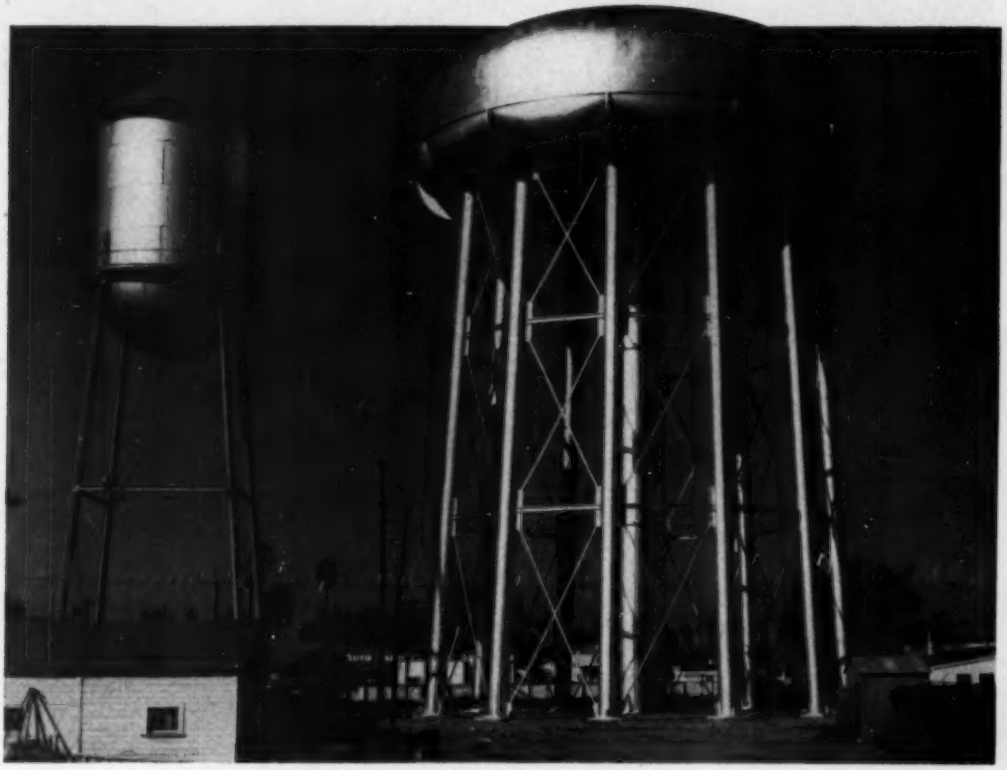
U.S. MOTORS

—embody

ASBESTOS PROTECTION
NORMALIZED CASTINGS
LUBRIFLUSH LUBRICATION

CARRYING ON A TIME-TESTED TRADITION



SINCE 1913, Horton elevated storage has been daily providing Oxnard, California, with better, more dependable water service. A 150,000-gallon tank did the job until last year when, as a result of increased water consumption, a new 1,000,000-gallon radial-cone bottom tank was installed. This shining new structure will continue its faithful service for many years to come.

Here is time-tested proof of the effectiveness of Horton elevated storage in municipal water systems. It's a story that's repeated over and over again in hundreds of cities throughout the country. Such benefits as increased pressure, decreased pressure variations and lower pumping costs can't be overlooked.

Improve municipal or industrial water systems for years to come with Horton elevated water tanks. Capacities range from 5,000 to 3,000,000 gallons. Write our nearest office today for more information and prices. There is no obligation on your part.

HORTON

WELDED STEEL

STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

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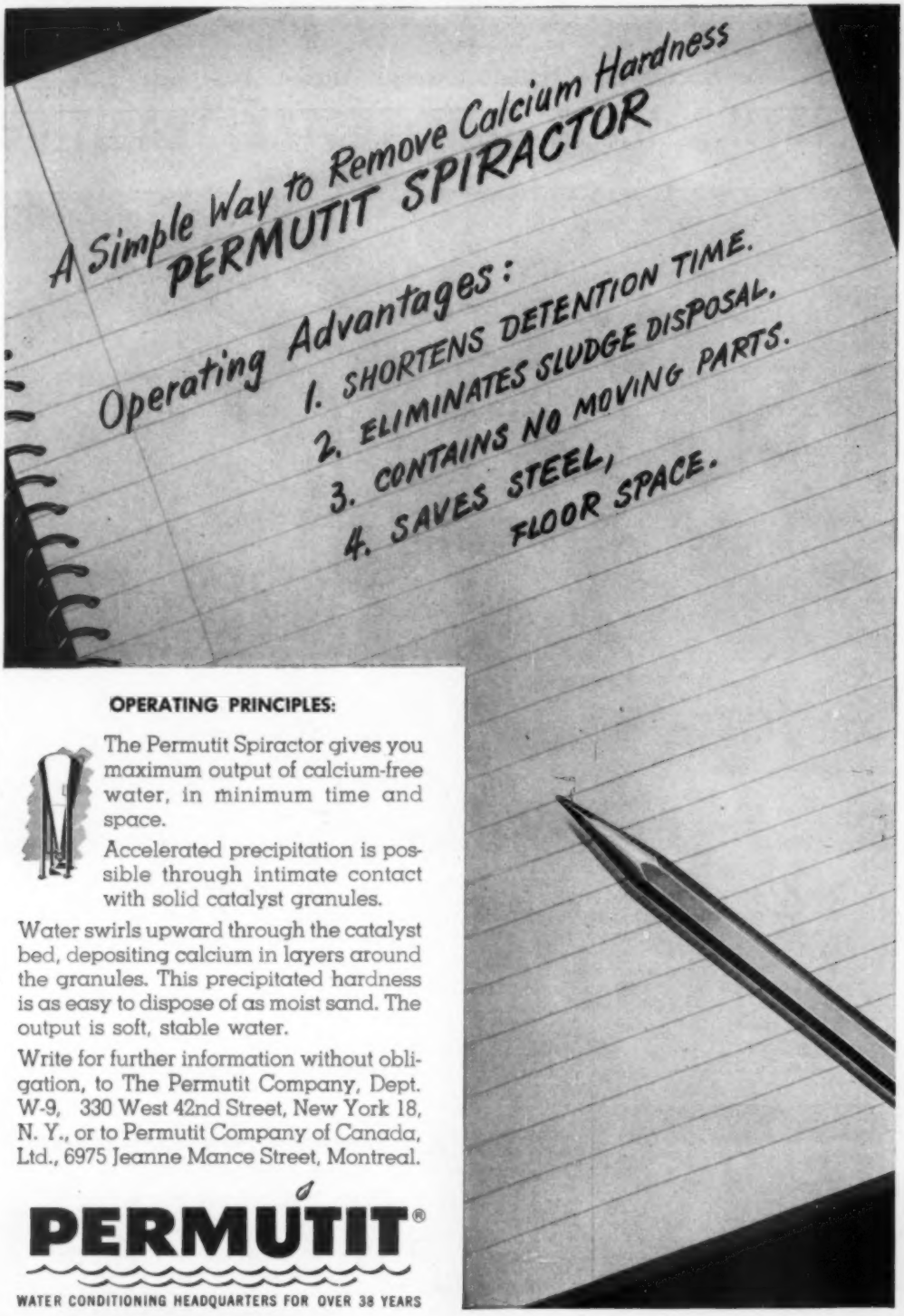
Birmingham 1	1586 North Fiftieth Street	New York 6	3390-165 Broadway Building
Boston 10	1048—201 Devonshire Street	Philadelphia 3	1644—1700 Walnut Street Building
Chicago 4	2190 McCormick Building	Salt Lake City 4	860 West 17th South Street
Cleveland 15	2262 Guildhall Building	San Francisco 4	1503—200 Bush Street
Detroit 26	1551 Lafayette Building	Seattle 1	1350 Henry Building
Havana	402 Abreu Building	Tulsa 3	1646 Hunt Building
Houston 2	2115 National Standard Building	Washington 6, D.C.	1109 Cafritz Building


A Simple Way to Remove Calcium Hardness
PERMUTIT SPIRACTOR
Operating Advantages:
1. SHORTENS DETENTION TIME.
2. ELIMINATES SLUDGE DISPOSAL.
3. CONTAINS NO MOVING PARTS.
4. SAVES STEEL, FLOOR SPACE.

OPERATING PRINCIPLES:

The Permutit Spiractor gives you maximum output of calcium-free water, in minimum time and space.

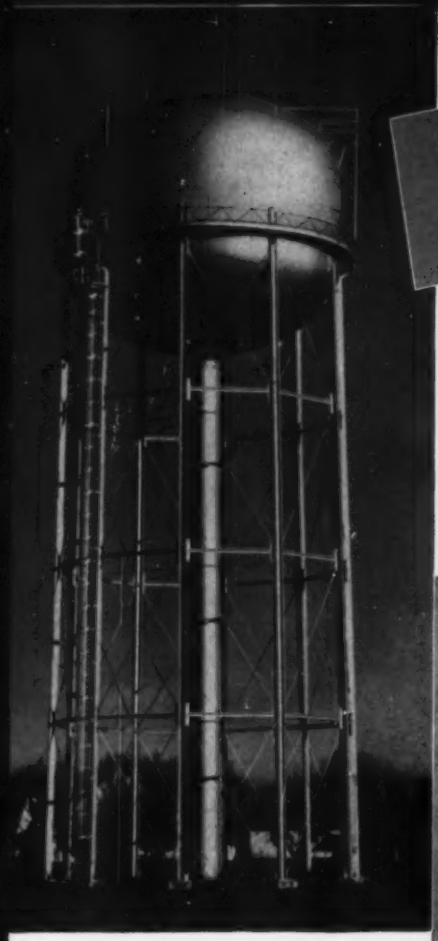
Accelerated precipitation is possible through intimate contact with solid catalyst granules.

Water swirls upward through the catalyst bed, depositing calcium in layers around the granules. This precipitated hardness is as easy to dispose of as moist sand. The output is soft, stable water.

Write for further information without obligation, to The Permutit Company, Dept. W-9, 330 West 42nd Street, New York 18, N. Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

PERMUTIT®

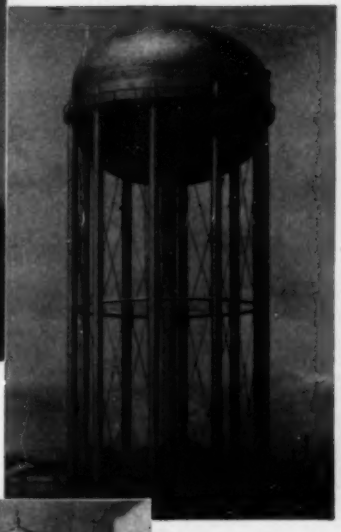
WATER CONDITIONING HEADQUARTERS FOR OVER 38 YEARS

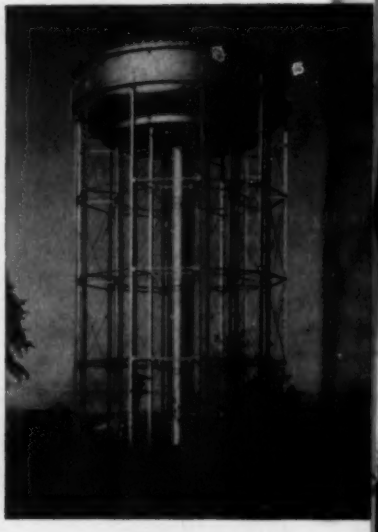


EVERY TYPE AND SIZE—
FOR EVERY NEED!

Elevated Steel Tanks

by PITTSBURGH • DES MOINES





Write today for our complete Elevated Steel Tank Brochure

For all municipal water storage requirements, Pittsburgh-Des Moines Elevated Steel Tanks are supplied in a wide range of designs, and in capacities up to 2,500,000 gallons. • Uniform pressures around the clock, supply during interruptions in pumping, lower pumping costs are but a few of the many reasons for this low-cost investment.

May we discuss the facts with you?

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25)	3318 Neville Island	DES MOINES (8)	919 Tuttle St.
NEW YORK (7)	Room 918, 270 Broadway	DALLAS (1)	1223 Praetorian Bldg.
CHICAGO (3)	1222 First National Bank Bldg.	SEATTLE	926 Lane Street
	SANTA CLARA, CAL.	625 Alviso Road	

These are the straight facts... the complete story on "Century" Asbestos-Cement Pressure Pipe

IN hundreds of communities, in nearly every section of the country, "Century" Asbestos-Cement Pressure Pipe is saving taxpayers' dollars by providing trouble-free water main service. Here are the actual facts on "Century" Pipe for your consideration in your own water main requirements.

History of Asbestos-Cement Pipe

For several years prior to 1920, engineers in this country received reports of a revolutionary new kind of pipe that was being widely and successfully used in Europe. It was said to have great durability, and to require none of the costly maintenance that had long been accepted as matter-of-course in the distribution of water throughout a community. This pipe was, of course, Asbestos-Cement Pipe. It was first manufactured experimentally in 1913, and within three years was established on a commercial basis. By 1921, seamless Asbestos-Cement Pipe was generally accepted for many important water mains and other pressure services throughout Europe. In that same year, the manufacturing process was patented in the principal industrial countries of the world. Today, "Century" Asbestos-Cement Pipe is a truly modern pipe—improved by Keasbey & Mattison and made with the help of new technological discoveries and manufacturing methods.

Strong and Durable

In water main service, long pipe life is a primary consideration. The two ingredients of "Century" Pipe—asbestos and portland cement—have been known and used for years for projects that were built to endure. The special Keasbey & Mattison process also contributes to building exceptional strength into "Century" Asbestos-Cement Pipe. And K&M's system of rigid quality control is further assurance of high strength and uniform quality. As a routine manufacturing step, every section of "Century" Pipe is hydrostatically tested in excess of its stated working pressure to insure an ample factor of safety.

Non-Corrosive

Corrosion is an external enemy which first weakens pipe and then ultimately destroys some types of pipe. This means that waterworks are, in many instances, faced with the necessity of replacing part or all of a line. "Century" Asbestos-Cement Pipe, being non-metallic, cannot corrode. Nor is it affected by stray electric currents. Therefore it is also immune to electrolysis—another common type of pipe enemy.

Non-Tuberculating

Tuberculation is a pipe enemy from within. It increases friction and progressively reduces flow area. But non-metallic "Century" Asbestos-Cement Pipe cannot tuberculate. The flow area is fully maintained and friction is kept to a minimum . . . insurance against increased pumping cost over the years.

Strong, light-weight "Century" Pipe is easy to handle, easy to lay.

Easy to Handle—Easy to Lay

The comparatively light weight of "Century" Pipe makes handling easier. Generally speaking, when the installation recommendations supplied with the pipe are followed, even with unskilled labor "Century" Asbestos-Cement Pipe can be laid easily, simply, and quickly.

"Century" Simplex Couplings

"Century" Simplex Couplings are installed quickly, easily, even by unskilled labor.

Simplex Couplings are made of the same materials—asbestos and portland cement—as the "Century" Pipe. They give you a combination of immediately and permanently tight joints that are also flexible, providing for up to 5° deflection. Simplex Couplings have only three parts: the asbestos-cement sleeve and two specially compounded round rubber gaskets. Assembly is quick and easy.

High Re-use Value

An important "plus". "Century" Pipe is so strong, durable and resistant to the wear of time, that it can be removed and relaid in its original pressure class at any time, using the same Simplex Couplings from the original installation.

Free Booklet

"Mains Without Maintenance" is a valuable reference book for anyone interested in pipe for water mains. *FREE*—write for it.

Nature made Asbestos...

Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

SIMPLICITY of AMERICAN METERS

MEANS A SMALLER STOCK OF PARTS

With fewer moving parts and a more simple construction than most water meters, maintenance and repair cost of American Meters is unusually low. Parts stocks are kept at the absolute minimum both for number of items and quantity of each one.

For example, all intermediate gear train parts are supplied individually. Measuring chamber halves can be replaced separately, not just as a complete factory-matched assembly. One part of an assembly replaced today must make a perfect fit with the rest of the parts though they be 20 or 30 years old.

Write for full details.

BUFFALO METER CO.

2909 MAIN STREET, BUFFALO 14, NEW YORK

For maximum economy in non-pressure sewer lines . . .

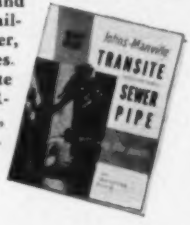
Specify TRANSITE SEWER PIPE with new RING-TITE JOINTS

Whether you plan to extend existing sewer lines, or build a complete new system, you'll want to check into the money-saving possibilities offered by Transite Sewer Pipe with its new Ring-Tite Couplings.

Without the need for hot jointing compounds, this factory-made coupling is quickly and easily assembled to make a tight joint that stays tight in service. This, plus the fact that Transite's long 13-foot lengths mean fewer joints in the line, cuts infiltration to a minimum. Thus, the load on the disposal plant is cut down, treatment costs reduced, and plant capacity conserved for future needs. And, in the planning of new systems, smaller treatment plants and smaller diameter sewers may be considered . . . with resultant savings in money, time and labor!

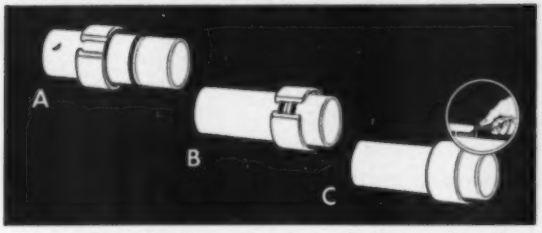
Important installation savings are possible, too, with Transite Sewer Pipe. Its relatively light-weight, long 13-foot lengths, and easy-to-assemble Ring-Tite Couplings speed completion of the line. It can be readily cut on the job for closures and branch connections. And its high flow capacity (Manning's n=.010) often permits flatter grades and shallower trenches with savings in excavation, sheeting, etc.

Transite Sewer Pipe is made of asbestos, cement and silica by a special Johns-Manville process which develops maximum strength and corrosion-resistance. It is available in sizes to 36" in diameter, for non-pressure sewer lines. For further information, write for your copy of folder TR-103A. Address Johns-Manville, Box 290, New York 16, N. Y.



Transite is a registered Johns-Manville trade mark

HERE'S HOW THE RING-TITE JOINT WORKS:

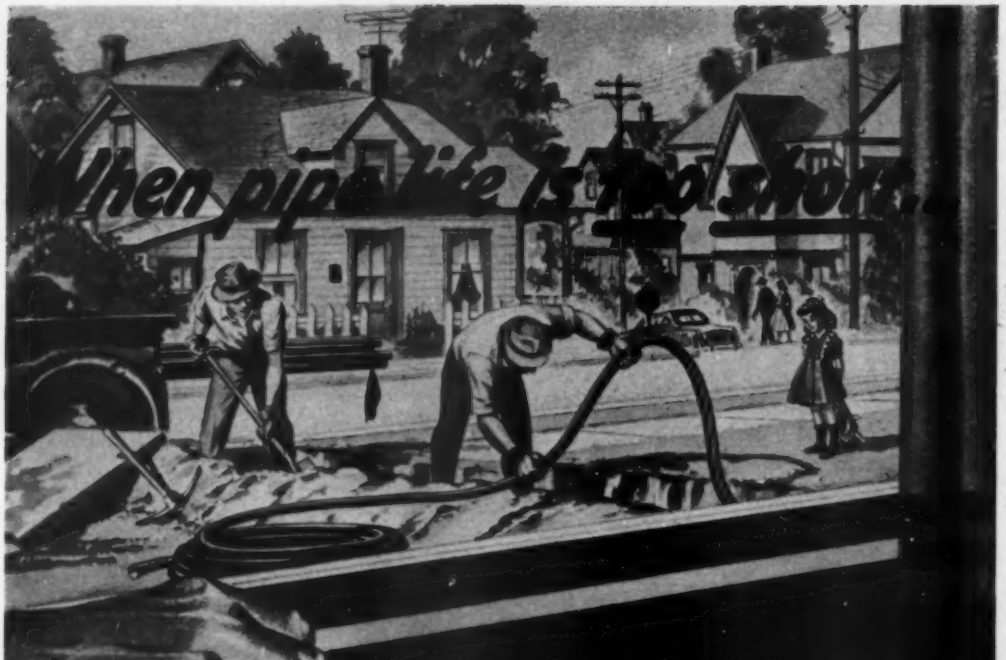


(a) Start of assembly. Two rubber rings and a Transite sleeve (cut away to show position of rings) are placed on one of the two pipe ends to be joined; (b) Final position. Sleeve centered over both pipe ends, with the rubber rings tightly compressed between sleeve and pipe; (c) Checking joint for proper assembly. This is done with a simple gauge immediately after the joint is made . . . *before backfilling.*

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE SEWER PIPE

This HERSEY DETECTOR METER
is used on the Fire Services of most of the large Industrial plants in our country
Experienced Water Works Officials will tell you why
HERSEY MANUFACTURING CO., SOUTH BOSTON, MASS.



SPECIFY CARLON PLASTIC PIPE!

Costly, periodic replacement of water lines because of electrolytic corrosion or interior build-up is reduced to minimum when CARLON plastic pipe is installed. This new pipe is guaranteed against rot, rust and electrolytic corrosion, and its smooth internal surface will not accumulate rust or scale. CARLON pipe assures permanent free flow and features a trouble-free service life many times longer than ordinary pipe.

CARLON pipe service line installations can be accomplished quickly and easily because of its extreme light weight. Flexible types, furnished in long lengths, require fewer fittings per installation and can be curved to follow ditch line or structural contour. Rigid CARLON is supplied in threaded and coupled random 21-foot lengths. In addition, a complete line of plastic fittings incorporating standard I.P.T. is available for connecting both types of CARLON plastic pipe to established systems. Complete adaptation from corporation stops to CARLON pipe is provided through standard adapters.

Remember, for longer pipe life, specify CARLON . . . THE FIRST REAL PIPE THAT IS PLASTIC!

At present, raw material shortages are limiting the production of certain types of CARLON pipe. Every effort is being made, however, to overcome this problem and to meet the growing demand and need for CARLON plastic pipe.

CARLON CP

CARLON PRODUCTS CORPORATION

IN CANADA MICRO PLASTICS, LTD ACTON ONTARIO

10132 MFECH AVENUE • CLEVELAND 5, OHIO

Just Out!

NEW 36-PAGE EDITION OF

PIPING POINTERS

...a bigger, more helpful handbook for training maintenance workers

You asked for ¼ million copies of the last edition of Piping Pointers. You found it a big help in training beginners and refreshing veterans in your piping crews. The bigger and better edition is just out—changed in appearance but not in purpose. Crane again offers this booklet—to help keep your piping systems at peak efficiency.

Piping Pointers talks facts . . . not theory. Thoroughly covers the fundamentals of good, sound, everyday piping practices . . . in easy-to-grasp, nontechnical language. Its many "how-to-do-it" features are illustrated for easy understanding.

Mistakes in piping installation and maintenance cost more today. Piping Pointers can help your men avoid them. Just ask your Crane Representative for a copy.

PARTIAL INDEX TO PIPING POINTERS

HOW TO choose valves for every service . . . install valves . . . read reducing fittings . . . make up screwed joints . . . assemble flanged joints . . . make up solder joints . . . install pressure regulators . . . use vent and drain valves . . . avoid steam trap trouble . . . save on pipe joints and materials . . . handle piping tools.

plus THE CRANE VALVE SELECTION GUIDE

which saves time and effort in selecting valves for common piping services.

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A 30-minute motion picture that dramatizes the fundamental information in the Piping Pointers Manual. Ideal for classroom or plant training groups. Available on request through your local Crane Branch.

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VALVES • FITTINGS • PIPE • PLUMBING • HEATING

Designs from engineers' notebooks

Inclined Sluice Gate in EVERDUR

In this design for 12 sluice gates 36 in. x 36 in. to operate at a 20-degree angle from the vertical, Everdur* (ANACONDA Copper-Silicon Alloys) was chosen for all the structural components, including gates, guides, stems and anchor bolts. While Everdur's immunity to rust, resistance to corrosion and high structural strength are essential to any installation of this nature, they are of special significance here in view of the higher friction component inherent in the angular installation.

These 12 gates are a part of an installation of 57 Everdur gates built for The Overpeck Valley Joint Sewage Works, Bergen County, N. J., Bergen County Sewer Authority. They were designed and built by The Coldwell-Wilcox Division of Krajewski-Pesant Mfg. Corp. to plans and specifications of Bogert-Childs Engineering Associates of New York.

Everdur has long demonstrated its ideal properties for waterworks, sewage installations, and disposal of industrial wastes. These strong, lightweight and easily welded alloys are widely used for such wrought assemblies as screens, float chambers, weirs, troughs, manhole steps and similar equipment. For full details just write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

where corrosion resistance counts—consider

ANACONDA®

COPPER-SILICON ALLOYS

*Reg. U. S. Pat. Off.

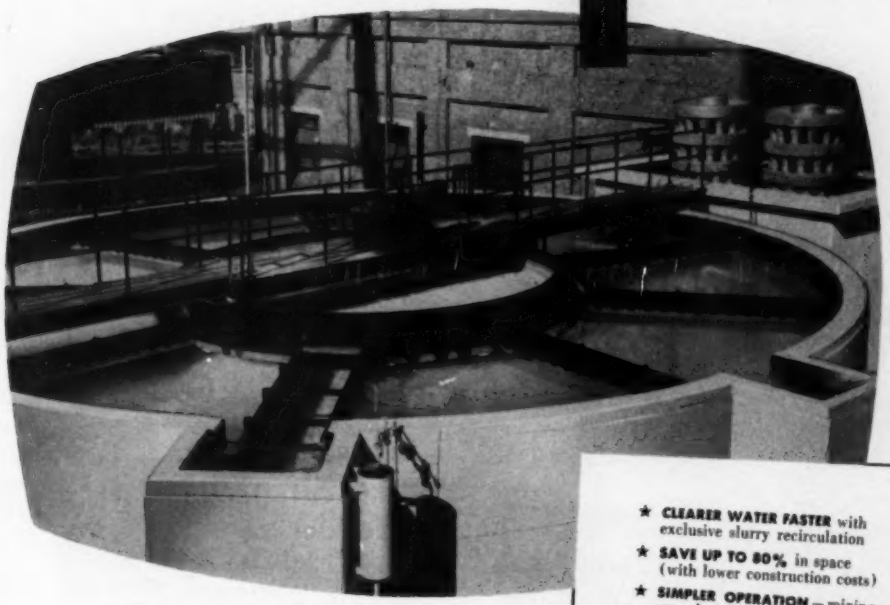
AT OCALA, FLORIDA

compact **Infilco** *plant softens 4 M.G.D. with ACCELATOR only 44 ft. in dia.*

clear, non-corrosive soft water with

Accelator®

In treating well water of 20 grain per gallon hardness this Infilco installation uses the slurry recirculation principle of the Accelator to soften and clarify a comparatively large volume in very small space. Settling basins are eliminated. Effluent is clear, aerated for non-corrosiveness, and reduced in hardness to 5 gr. per gallon.



★ **CLEARER WATER FASTER** with exclusive slurry recirculation
★ **SAVE UP TO 80%** in space (with lower construction costs)
★ **SIMPLER OPERATION** — mixing, coagulation, clarification and sludge removal all in one unit
★ **FASTER CHEMICAL REACTION**
★ **HIGH RATINGS**

Plant Engineered by
RUSSELL & AXON *Daytona Beach, Florida*

44 ft. diameter Accelator — with automatic chemical feeders and central controls. 2 Multicone Aerators
3 Filters, each 16 x 22 ft. with Wagner underdrains.
Serves population of 11,588 with average daily use of 1.5 m.g.d. and capacity of 4.0 m.g.d.

INFILCO
BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1934

INFILCO INCORPORATED | *Tucson, Arizona*

FIELD ENGINEERING OFFICES IN 26 PRINCIPAL CITIES

World's Leading Manufacturers of Water Conditioning and Waste-Treating Equipment

We don't seriously suggest that sponsoring the General Electric Disposall® will actually win you a permanent memorial—but across the country more and more community leaders are earning the sincere thanks of their communities through planning multiple installations of this revolutionary G-E appliance. This electrical marvel shreds food-wastes into tiny particles and then *washes* them away to septic tank or sewer. And public support for the G-E Disposall grows more enthusiastic every day.

What this modern, electrical, more hygienic method of garbage removal has already done for other progressive cities provides striking proof of the economy and effectiveness of municipal G-E Disposall projects of this kind.

In Jasper, Indiana, for instance, installation of G-E Disposalls is already complete in two-thirds of all homes. The city's garbage collection service has been suspended.

In Herrin, Illinois, and Mount Dora, Florida, whole groups of housewives—thanks to the action of local leaders—now get rid of food-wastes the G-E way, simply by turning the kitchen faucet.

If you are in any way concerned with civic planning or sewage treatment, *now* is the time to consider this revolutionary means of making your city a better place to live.

Let us send you this booklet

G-E DISPOSALL

**CONVERTS FOOD-WASTE TO SEWAGE—
ELIMINATES "GARBAGE"**

Trim and specifications subject to change without notice.

Let us send you *"What Was Garbage?"*—a guide to municipal Disposall installations—an authoritative booklet that answers your questions on this great new advance in sanitation. No cost or obligation—just write General Electric Company, Box W11, Bridgeport 2, Connecticut.

You can put your confidence in—

GENERAL ELECTRIC

One of the largest (handling 30 million gallons per day) water works plants in the southwest (Phoenix) selected Jeffrey FLOCTROLS for the mixing basins — Jeffrey Sludge Collectors for the settling basins. Successful operation for several years has proved this a wise choice.

Other Jeffrey equipment installed in this plant includes: Grit Collectors; Rapid Mixers; Chemical Handling machinery such as Spiral Conveyors and Bucket Elevators.

Jeffrey also makes: Back-cleaned Screens, Grit Washers, Scum Removers, Garbage and Screenings Grinders, Chemical Feeders, Chains, etc.

CATALOG No. 833 TELLS ALL

THE JEFFREY MANUFACTURING COMPANY Established 1877

996 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

Baltimore 2 Boston 16 Cincinnati 2 Detroit 13 Houston 2 New York 7 St. Louis 1
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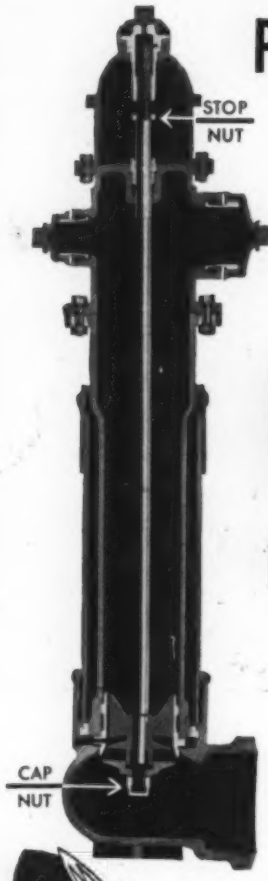


Protected against rough usage

The heavy-duty bronze stop nut stops the downward travel of the operating stem, preventing the fully thread-protecting cap nut on the lower end from touching the bottom of the elbow. Thus the stem of the Mathews Modernized Hydrant cannot be bent in operation, even when excessive pressure is applied.

MATHEWS HYDRANTS

Made by R. D. Wood Company

Public Ledger Building, Independence Square
Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

Mathews Modernized Hydrants offer these advantages:

Compression-type valve prevents flooding • Head turns 360° • Replaceable head • Nozzle sections easily changed • Nozzle sections easily raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Operating thread only part to be lubricated • All working parts contained in barrel —removable without excavating • A modern barrel makes an old Mathews good as new • Available with mechanical joint pipe connections

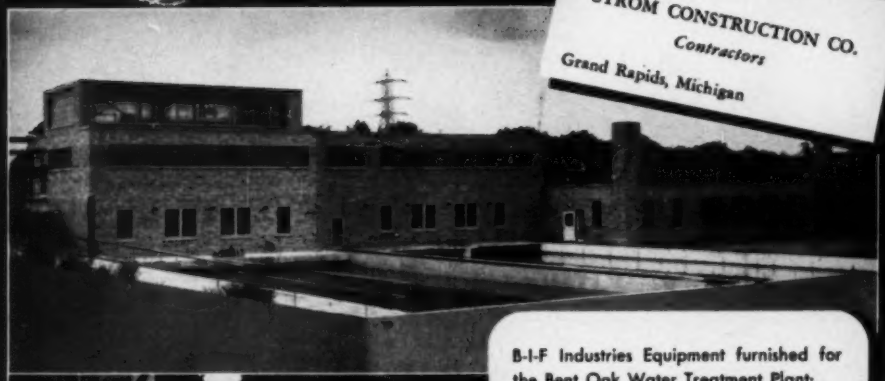
ADRIAN, MICH.

Bent Oak Water Treatment Plant

(COMPLETED IN 1951)

FINKBEINER, PETTIS & STROUT
Consulting Engineers
Toledo, Ohio

STROM CONSTRUCTION CO.
Contractors
Grand Rapids, Michigan



B-I-F Industries Equipment furnished for the Bent Oak Water Treatment Plant:

Omega Loss-in-Weight Gravimetric Feeders with Dust Collectors, for feeding soda ash and alum

Omega Belt Gravimetric Feeders with Slakers and Dust Collectors, for feeding quicklime

Builders Filter Effluent Rate of Flow Controllers

Builders Filter Loss of Head and Rate of Flow Gauges

Builders Clear Well Level Gauge

Builders Filter Operating and Raw Water Control Tables

Builders Raw Water Rate Controller and Meter

Builders High Service Venturi Meters

Builders Wash Water Orifice Meter

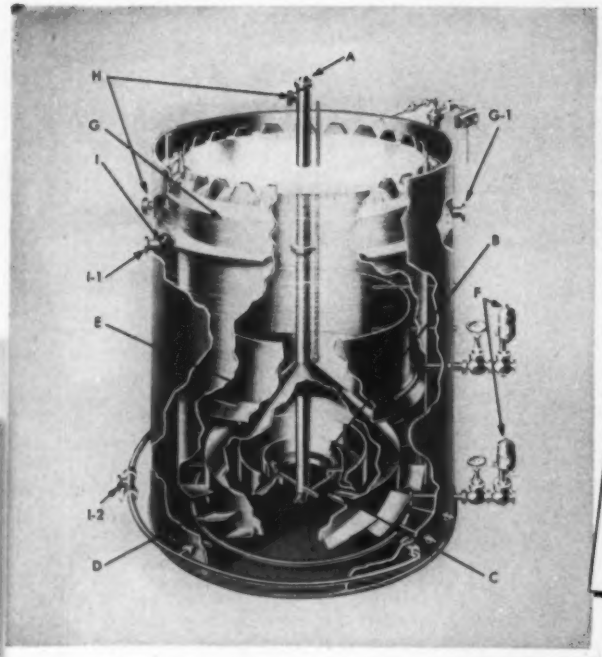
The first filter plant in Michigan was constructed for the city of Adrian in 1899. Today, these original facilities have been completely supplanted by the Bent Oak Water Treatment Plant, a 5 MGD rapid sand filter plant which incorporates the latest systems for water purification and for control of hardness. The new plant has been built on the "installment" plan. One filter was completed in 1945, the second in 1947, and two more in 1949. With the final completion of the plant in 1951, Adrian again can boast of having one of the outstanding water works of the State.

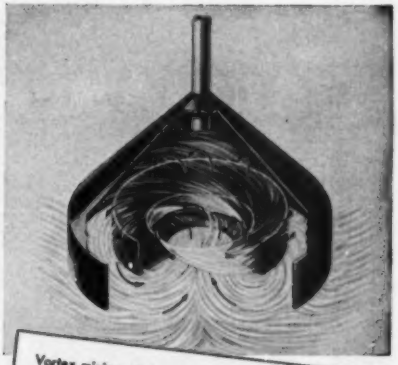
Operated under the direction of V. H. Langworthy, Plant Supt., and H. E. Smith, Water Board Supt., the plant must deal with a serious water hardness problem. Omega Feeders and Lime Slakers perform a vital function in this work, delivering quicklime, soda ash, and alum for coagulation and for pH control. For complete information on Omega Water Works Equipment, address Omega Machine Company (Division of Builders Iron Foundry), Providence 1, Rhode Island.

B-I-F INDUSTRIES

OMEGA
THE LAST WORD IN FEEDERS

Ω OMEGA





Vortex mixing eliminates need for submerged moving parts in the Worthington Cold Process Slurry Type Precipitation Water Softener and Coagulator.

REACTION TANK of Worthington Slurry Type Softener (Slurry bed eliminated for clarity). (A) Raw water influent line. (B) Vortexor for optimum slurry production. (C) Chemical Applicators. (D) Slurry bed rotator. (E) Symmetrical Slurry concentrator. (F) Proportionate sludge removal. (G) Collector trough for treated water. (G-1) Treated water effluent. (H) Complementary recirculation. (I) Filter wash water compartment. (I-1) Filter wash water suction. (I-2) Filter wash water return.

This slurry bed stays put!

. . . and troublesome variables are out

These Features Give You The Uniformity You Want

WORTHINGTON SLURRY TYPE PRECIPITATING WATER SOFTENER AND COAGULATOR gives consistent, uniformly softened water

If it's clear, uniformly softened water you want, this unique Worthington Water Softener is just what you need. Concentrated quick mixing and rapid recirculation of applied chemicals and raw water, *achieved by hydraulic energy instead of submerged mechanical moving parts*, is an important, progressive development in the water treatment field.

New Bulletin W-212-B5 gives you 16 pages of vital facts about this unique cold process water softening method. Write for your free copy today.

REMEMBER . . .

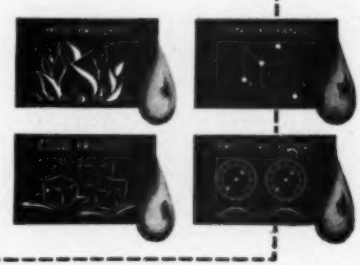
Worthington engineers *all four* water conditioning processes; therefore, can give you unbiased recommendations on which process is right for you . . . further proof that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Division, Harrison, N. J.*

J5-1

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



PICTURE OF EFFICIENT, DEPENDABLE, CONTROLLED DIGESTION IN THE MAKING

Engineers are:
Bogert-Childs
Engineering Associates,
Consulting Engineers.

SHOWN above, are four P.F.T. 80-foot diameter Foating Cover Digesters under construction for the Overpeck Valley Sewage Treatment Plant, Bergen County, New Jersey. The Floating Covers are ruggedly constructed from materials and designs developed as a result of over a quarter century of cover building experience and literally thousands of installations.

These digesters with four P.F.T. No. 423 Heat Exchangers, P.F.T. Selectors and Gauges and P.F.T. Gas Safety Equipment will provide the ultimate in a Controlled Digestion System with built-in flexibility for present and future needs.

Each of the P.F.T. No. 423 Heat Exchangers, shown at right, has a rated sludge heating output of 873,000 B.t.u. per hour and is provided with automatic controls to maintain within 1 degree the temperature of one of the digesters by circulating the digester contents through the Heat Exchanger. Waste heat from the sludge gas engines is utilized by circulating the engine jacket cooling water through the Heat Exchangers.

Here again P.F.T. equipment based upon P.F.T. experience gained in developing this modern method of external sludge heating and hundreds of successfully operating installations assures efficient and dependable operation.

P.F.T.

PACIFIC FLUSH TANK CO.

Waste Treatment Equipment Exclusively Since 1893

4241 RAVENSWOOD AVE. CHICAGO 13, ILLINOIS

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

The Complete Line of Brown Instruments Is Keyed to the Need of Every Process Variable

FOR GREATER EFFICIENCY

in Sewage Treatment

in Wastes Treatment

...THE *ElectroniK* pH RECORDER CONTROLLER

IF YOU'RE interested in sewage treatment, you want to use just enough chemicals to settle out the solids. And if you're interested in wastes treatment, you want to use just enough chemicals to effect neutralization and render the effluent harmless.

In either case, too much chemical addition means costly waste and too little means insufficient treatment. An *ElectroniK* pH Controller will automatically govern addition of chemicals in proper amounts and provide a permanent record of pH value . . . continuous assurance that your treatment of sewage or wastes is operating at peak efficiency.

For unusual sensitivity to changing conditions, for accurate and permanent record, for corrective action without delay . . . the *ElectroniK* pH Controller is your best bet. Call in your local Honeywell engineer for a discussion of your particular pH problem . . . he is as near as your phone. And write for a copy of Catalog 15-12. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4575 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS **Honeywell**

Brown Instruments

For Water Free from Odor and Taste, the Application of Carbon Must Be under Careful Control

CHEMICAL FEED ROOM, DALLAS, TEXAS, WATER PLANT

L. C. BILLINGS, the Southwest's authority on taste and odor control, Supervisor and Chief Chemist of Dallas' water purification, says:

"The operator can carefully control the application of activated carbon by means of the Threshold Odor Test. With a little training, this test is very simple to make. By training the nose to distinguish slight odors, the operator can readily determine how much carbon should be fed to remove an odor of a certain intensity.

"He should make this test daily in order to keep ready for any sudden appearance of intense odor.

"The Threshold Odor Test is widely used and recognized as the only method by which a water odor can be studied and thereby determine how proper feeding of carbon can be accomplished."

The manufacturers of Aqua Nuchar Activated Carbon offer the services of Threshold Odor Specialists to assist water purification plants in solving their taste and odor problems. Write to our nearest office today to arrange for a Threshold Odor demonstration.

NOTE: This series of advertisements is published with the idea of promoting production of uniformly palatable water, and the quotations from outstanding water works authorities should not be construed as being endorsements of any particular product.

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industrial CHEMICAL SALES
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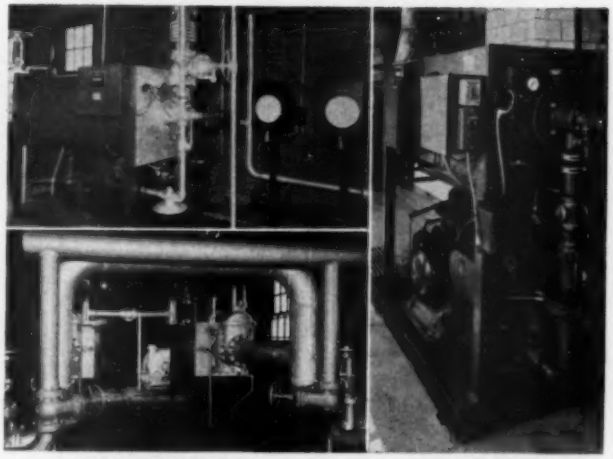
CARBALL for CO_2 Production

CARBALL FUNCTION

The CARBALL is the most efficient package carbon dioxide producer yet developed. It produces clean CO_2 gas for slightly over 1/2 cent a pound. The chemical efficiency from total carbon to alkalinity change is 92%! Accordingly, it will carbonate water for approximately 1/2 of the fuel consumption of other types of systems.

The burner receives fuel and air under pressure, so that gases leaving the producer are under pressure for self injection. The air compressor handles only cold air. Water jacket cooling water is available for lime slaking. Because the Carball unit burns gas or oil under a very high temperature (2600°F) there is no condensable carbon remaining and a clean tasteless CO_2 gas is obtained which doesn't require scrubbing before use.

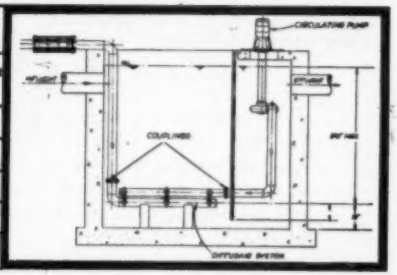
Since the CO_2 gas is under pressure from the burning chamber, the disadvantage of the older systems wherein the hot, corrosive gas was compressed is avoided. This amounts to a considerable saving in the size of and maintenance on the compressor.



COLUMBUS, OHIO — MOLINE, ILLINOIS

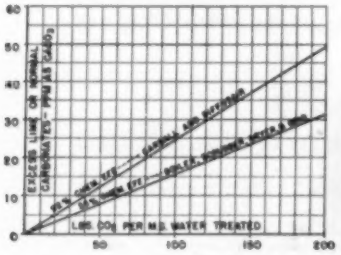
TABLE SHOWING CAPACITIES AND SIZES OF UNITS

	OIL — No. 3			GAS — NATURAL				DIMENSIONS			
Size	Pounds CO_2/Hr	cfm 14.5% CO_2	Oil gph	Pounds CO_2/Hr	cfm 10% CO_2	cfh of Gas	Water GPM	Length	Width	Height	Outlet Size
No. 0	20	20	0.9	13	20	120	3	6'-9"	20"	50½"	3"
No. 1	58	60	2.6	39	60	360	3	6'-9"	30"	54"	4"
No. 2	116	120	5.2	78	120	720	6	8'-6"	36"	60½"	6"
No. 3*	231	240	10.3	155	240	1440	12	12'-4"	38"	68½"	10"
No. 4*	576	600	25.7	390	600	3600	25	On Application			12"



*Blower (and gas booster if used) mounted separately on Size No. 4 units and on Size No. 3 units above 150 cfm.

Curves showing CO_2 requirements at 92% chemical efficiency in comparison to requirements when using older, less efficient methods.



DIFFUSAIR FUNCTION

The DIFFUSAIR is a most efficient device for diffusion of CO_2. CO_2 bubbled at 4 cfm from the center of each bronze cavitation dish is diffused into bubbles of dust-like fineness. The diffusion apparatus not only eliminates corrosion and the progressively poorer absorption obtained from an old fashioned grid system, but occupies only a small fraction of the latter's basin requirement; using only basin size for 1/2 minute of flowing-thru capacity and 8 feet of water depth.

WRITE FOR BULLETIN 7542

WALKER PROCESS EQUIPMENT INC.

PROQUIP PROCESS EQUIPMENT

FACTORY · ENGINEERING OFFICES · LABORATORY

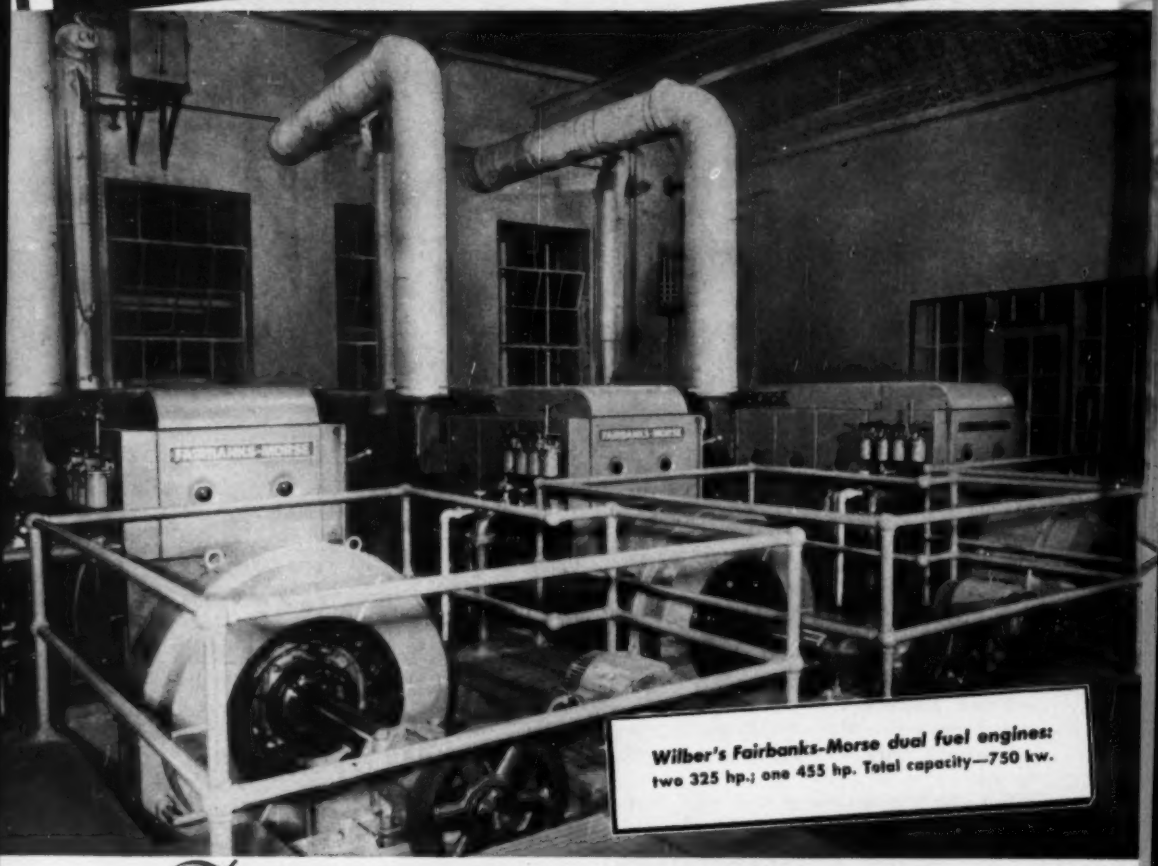
AURORA · ILLINOIS

Wilber's Saving $8000 Yearly with FAIRBANKS-MORSE Dual Fuel Power!

The 1455 people of Wilber, Nebraska, are enjoying a total savings of over $8000.00 a year, since the town started producing its own power in the first 100% dual fuel power plant in the state.

Burning economical natural gas, two Fairbanks-Morse Model 31 dual fuel engines give the Wilber plant ample capacity with plenty of standby power for emergency.

Fairbanks-Morse dual fuel engines operate economically on sewage gas that is normally lost or wasted, as well as on natural gas and diesel oil. They mark a new avenue towards lower power costs for your community. Fairbanks, Morse & Co, Chicago 5, Ill.



Wilber's Fairbanks-Morse dual fuel engines: two 325 hp.; one 455 hp. Total capacity—750 kw.

FAIRBANKS-MORSE,

a name worth remembering

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • ELECTRICAL MACHINERY
PUMPS • SCALES • RAIL CARS • MAGNETOS • FARM MACHINERY

SEE HIM? NEW ON THE JOB TODAY BUT HE'S MAKIN' UP JOINTS LIKE AN EXPERT!

It doesn't take specialized training or skill to join pipe with Dresser Couplings. Ordinary workmen can make permanent, flexible joints every time.

Why? Because Dressers come to the job ready to use, with the skill already built in. Parts are few and accurate. Assembly is simple and fast. Leakproof joints are assured because Dressers provide controlled gasket pressure through controlled bolt tightness around the joint.

And with long sections of steel pipe, there are fewer joints to make, lines are completed and in service sooner.

A Dresser-Coupled steel line has lifelong resilience. Absorbs stresses of expansion, contraction and vibration that cause so much trouble for rigid or caulked lines. Dressers save man-hours on installation and maintenance, too.

DRESSER

"FLEXIBLE-TIGHT"

COUPLINGS

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: 629 Adelaide Street, W., Toronto, Ontario

Dresser Couplings come in sizes ⅜" to 72" and larger. Ask your Dresser Sales Engineer for latest data and follow-through service, or write to our main office.

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Big Producers

AT KEY WEST, FLORIDA

Seven Layne Well Water Supply units, each testing around 8,000 gallons per minute, have been installed to furnish cooling water for a power project at Key West, Florida. Permanent installations will be Layne Vertical Turbine type Pumps, each having a capacity of 2,300 gallons per minute. Preliminary tests indicate that efficiency will be much higher than promised.

Layne's method of designing, building and installing well water supply units is fully proven in higher production and lower operation cost. All installations are by Layne's own field crews and the work, from start to finish, is under the constant supervision of Layne engineers. Thoroughly tested before final delivery, Layne wells and pumps provide the utmost in dependability and long life. For further information, catalogs, bulletins, etc., address

LAYNE & BOWLER, INC.
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WELL WATER SYSTEMS

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Layne contracts for and builds complete well water supply systems of any size or capacity and for any need such as cities, factories, ice plants, packing houses, paper mills, railroads, pipe lines, petroleum refineries, chemical plants, air fields, irrigation farming and many other places where big quantities of well water must be obtained at low cost.

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WATER SUPPLY
WELLS & PUMPS

It Pays Double to Standardize on HOMELITE *Carryable* EQUIPMENT

Homelite Carryable Pumps
for fastest automatic pumping on all types of dewatering jobs

Homelite Carryable Generators
for instant, dependable power, for floodlights or electric tools

Indeed it does! In the first place when you standardize on Homelite Pumps and Generators you give your men the best. Easy to operate, *sure* to operate, they're all powered by the famous Homelite built-in gasoline engine . . . a dependable, weather-proof, dustproof, foolproof engine that assures best performance at all times.

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If leaking valves are fouling your gas and sludge lines, the most likely reason is seat failure. Install the valves with unexposed seat and tapered plug—NORDSTROMS

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Nordstrom
LUBRICATED VALVES
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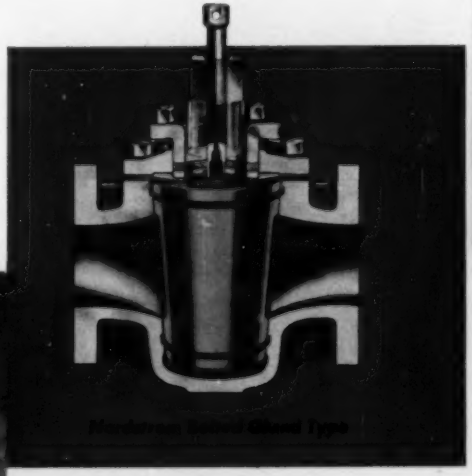

Nordstrom Valves on sewage sludge lines

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400 North Lexington Ave., Pittsburgh 8, Pa.
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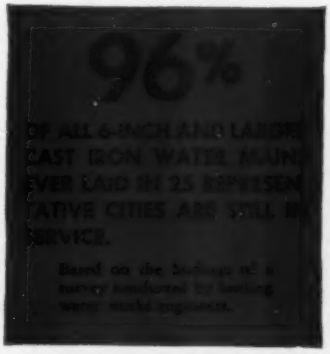
A north country trapper... like Cast Iron Pipe...has

Trekking long distances in the frozen North, on a trapline or behind a dogsled, demands stamina! And, just as surely, pipe *must* have stamina to serve for a century or more as cast iron water and gas mains are doing in more than 30 cities in the United States and Canada. In the generations since these gallant old mains were installed horse-drawn vehicles have given way to multi-ton trucks and buses. Under the streets crowded utility services have been constructed. Yet cast iron pipe has withstood the resultant traffic-shock and beam-stresses because of its shock-strength, beam-strength and crushing-strength.

No pipe, deficient in any of these strength-factors of long life, should ever be laid in paved streets of cities, towns and villages.



CAST IRON PIPE

STAMINA!*

*In a 340-mile midwinter race against death to bring serum to Nome, Alaska, a dog-team and driver covered more than 90 miles in a single day—a feat still remembered after 25 years.

CAST IRON

CAST IRON PIPE RESEARCH ASSOCIATION; THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

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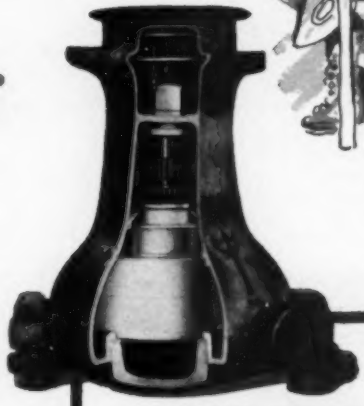
IS OLD MAN "DEPRECIATION" WORKING ON YOUR METER BOOKS?

He goes **OUT** *and stays out* **WHEN TRIDENTS® COME IN . . .**

When users point to Trident Water Meters installed in 1898 and say: "Those meters are as valuable as the day we bought them" . . . that means Old Man Depreciation NEVER had a chance to get at Trident Water Meters. You see, Trident just doesn't replace old parts in old style meters. Trident provides new and better interchangeable parts, better in design, construction, operation, for meters whose sound basic design has never changed . . . Meters that don't depreciate and don't become obsolete . . . TRIDENTS.



BECAUSE NEPTUNE'S BASIC POLICY OF INTERCHANGEABILITY PROVIDES IMPROVED MODERN PARTS THAT FIT PERFECTLY INTO OLD TRIDENT CASINGS TRIDENTS DON'T DEPRECIATE DON'T BECOME OBSOLETE

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WATER & SEWAGE WORKS

VOL. 98, NO. 11 • A GILLETTE PUBLICATION • NOVEMBER 1951

VIRGINIA'S SOUTH RIVER and gaging station near DuPont's Waynesboro Plant.

Pollution Abatement Program at DuPont's Waynesboro Plant

Featuring waste curtailment through process and equipment changes, rendering treatment of plant effluents unnecessary.

by ROY McCRACKEN, *Technical Specialist E. I. du Pont Co., Waynesboro, Va.*

THE du Pont Company had long known that manufacturing operations at their acetate-rayon plant in Waynesboro, Virginia, were accompanied by normal material losses that appeared in industrial wastes being discharged into the small South River running close to the plant. In the late thirties the condition of this stream below Waynesboro became so foul that a large group of farmers and other riparian landowners drew up a petition requesting that steps be taken to abate the existing nuisance. This petition was presented to the City Council of Waynesboro.

The petition cited the dumping of municipal sewage as one of the two main sources of pollution and claimed that local industries were also major contributors. The town employed a firm of nationally known consulting engineers to determine Waynesboro's place in the pollution picture and recommend a plan for treating sewage. The consulting engineers reported that municipal sewage should be given complete treatment and that industry should substantially reduce their oxygen consuming wastes.

Up until this time no concerted effort had been made by the town, the State, nor the du Pont plant to accurately and completely evaluate the stream pollution at this location.

A Joint Venture—Industry, Municipality and State

In 1948 a joint venture was organized with participants being the town of Waynesboro, three major industries located in Waynesboro, and representatives of the Virginia State Water Control Board. The purpose was a more detailed study of the South River above and below Waynesboro to determine the effects of the various waste discharges and to find out where the river recovered, if at all. Costs were borne jointly by all participating parties on a cooperative basis—those with more abundant manpower assumed the burden of collecting samples while those with laboratory facilities and trained personnel agreed to share analytical work. All results were discussed by a joint committee and decisions were based on complete agreement. As a result a clearcut picture of the South River was developed and the responsibility and magnitude of the several sources of waste was clearly established.

Of equal, if not greater benefit, there has been established a feeling of cooperation and trust. Industry learned what it could be held responsible for and has, thereby, been in a better position to plan a program of

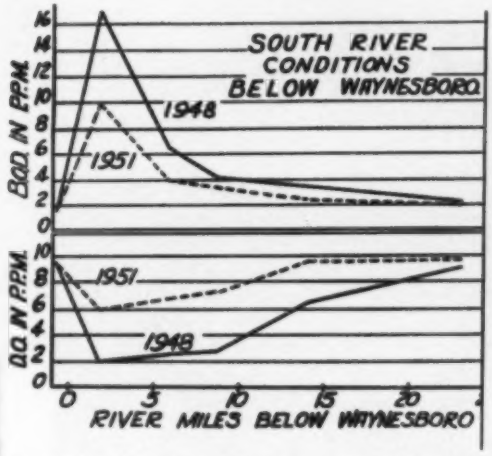

Fig. 1—PROGRESSIVE IMPROVEMENT in condition of South River below Waynesboro.

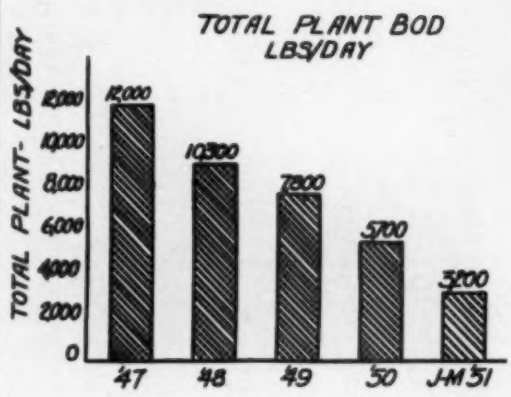

Fig. 2—PROGRESSIVE REDUCTION of pollution load on South River from DuPont's plant.

pollution abatement. So have the city officials—and each participant knows of the others' problems. The State Water Control Board, with the responsibility for having the stream cleaned up, has the same information and is aware of the things which have been done, and of what is needed for a final and satisfactory answer to the problem.

The foregoing may seem to indicate that all was "fair" during the years encompassed by the above developments and that the improvement was more or less spontaneous, but such was not the case. A lot of hard work, cooperative effort and money went into the program as will be detailed in the discussion which follows.

A study of the records of the flow of South River over the past 18 years, reveals minimum flows of the order of 25-50 cfs. Average yearly flow is 139 cfs, with flood flows of 4000-7000 second feet for the period 1930-1948. However, the average year's flow drops to 60 cfs in very dry years.

The stream must assimilate the domestic sewage of the city of Waynesboro (pop. 12,000), and the wastes from the local industrial plants. The cooperative study, mentioned earlier, brought out the fact that the stream was then loaded with about 15,000 lbs. BOD/day and that as a result of this load on the stream, it was grossly polluted for 15 miles down stream. The dissolved oxygen was very low, ranging from 0 to 3 parts per million, for a considerable stretch down stream from Waynesboro, as revealed in Fig. 1. Color of the stream was bad and foul odors were often noted.

Since 1947, work at the du Pont acetate-rayon plant on stream pollution abatement has been continuous, as becomes evident when noting Figs. 1 and 2. An examination of Fig. 2 reveals that five years ago the organic wastes from the plant accounted for about 11,000 to 12,000 lbs. of B.O.D. loading per day on the river. These loadings have systematically been reduced to 3,200 lbs., or 30% of this former level. The chart does not show it, but this loading reduction has been accomplished in the face of a 50% increase in rayon production in the Waynesboro plant during this period.

Fig. 1 shows that during the past few years the B.O.D. of the river has gone down considerably and the dissolved oxygen up. The odor and appearance of the stream has improved to a point where this is now a fairly decent stream.

Methods of Accomplishment

How has all this been accomplished? The first thing of note is that it has been the result of elimination of waste at the source. Such has been accomplished through changes in process and equipment rather than through waste treatment. This has been done with substantial reductions in cost resulting in several instances through savings which have resulted. While it is true that not all wastes are subject to reduction at the source, it is surprising and sometimes incredible what reductions can be made when the losses are worked on seriously. To illustrate, I would like to discuss a few outstanding items.

The acetate-rayon process at Waynesboro operates roughly along the flow pattern shown in Fig. 3. In the process acetic anhydride was produced from calcium carbide. This has since been changed and we will come back to such change shortly.

The acetic anhydride is reacted with cellulose to produce cellulose acetate and acetic acid. A big part of the acetation operation is that of recovery of the acid as glacial acetic.

The cellulose acetate after washing and drying is dissolved in acetone and spun into acetate rayon. This untwisted yarn may be shipped to the customer, or it may be "thrown," i.e., twisted, packaged in different forms such as cones or beams, and then shipped.

Some of the items which have been reduced or eliminated are the following.

Previously, acetic anhydride was manufactured in the plant by the ethylidine diacetate process. This involves calcium carbide as the starting material to generate acetylene which is reacted with acetic acid to eventually produce acetic anhydride. The process yields an appreciable amount of wastes. First, the carbide gives a large tonnage of lime sludge. This waste carbide sludge containing free caustic lime was pumped from the operation as a slurry and the lime settled out. On one occasion we had a bank of a settling pond break allowing slurry to run into the river. The result was a big fish kill, which doesn't do an industry's public relations any good. The settled out sludge is a mud, which, because of its high moisture content (50%) is difficult to get rid of, although it is excellent for liming land. There is still 333,000 tons of it, a right formidable white elephant, stacked up at Waynesboro.

The second waste problem of the

EDA process is the formation of by-products and of tars. An incinerator of special design was used to burn the more combustible of these and the black gooey tars were hauled to dump pits where rather unsuccessful attempts were made to burn this material on the ground. Incidentally, these pits are now being burned by injection of 80-pound compressed air into the burning molten tar.

Abandonment of Acetic Anhydride Manufacture

Manufacture of acetic anhydride at Waynesboro has been abandoned and the anhydride is purchased. However, just in passing, I should say that numerous things were done which decreased the wastes to one-half the original amount as shown in Fig. 2, before the production of the anhydride was abandoned. While it may not be often that a plant for manufacture of a chemical can be obsoleted and the waste problems completely eliminated by getting the material elsewhere, such was done in this instance. The B.O.D. to the river from this section simply isn't there any more.

Process Alterations for Additional Benefits

Another example, cellulose acetate is precipitated from acetic acid solution. The diluted acid must be completely washed out of the acetate with the very minimum poundage of both acid and acetate to the sewer. Alterations have been made in the process and technique of washing. These alterations have reduced the losses to one fourth of what they were previously.

THE AUTHOR

Shows graphically the progress in pollution load reduction from the Waynesboro plant during the past 4½ years.

In this attainment the precise performance of each individual operator is an important factor. To assist the operator in the performance of his duties, many tools for controlling the acid losses are provided, such as acid meters to continuously indicate on a chart the rate of acid loss as well as laboratory analyses of waste ditch waters to determine acid losses by 8-hour shifts. Nevertheless, good morale, cooperation, and a real desire on the part of every operator to keep waste down are necessary to successful performance in this part of the waste reduction program.

A serious cause of loss is failure of a human being as distinguished from failure of equipment. There are instances in which the operator fails to function and causes a loss of materials. For example, he may leave a valve open and let material run to the sewer for some time before something, either the material itself or someone, causes correction. A common error is for the operator filling a tank to run it over. If equipment can be provided such as an automatic shut-off or catch tank, this will prevent this type of loss.

Installation of More Efficient Equipment

The acid recovery operation was redesigned and replaced with modern, more efficient equipment.

Waste elimination was not the only reason for this new equipment, since this operation involves an ether extraction which was a recognized safety hazard under former operating conditions. This improved equipment reduced the losses of acetic acid in the recovery operation to about 1/30th of what they were previously, in addition to improving safety, reducing power and water requirements, and operat-

POLLUTION CONTROL LAB., DuPont's Waynesboro Acetate Rayon Plant.

COOPERATION between operator and foreman is the keynote in successful pollution abatement by corrections at the source.

ing costs. Actually, equipment was installed to reduce losses beyond what heretofore had been considered to be economical limits. Such added expense muct be charged to pollution abatement, but has proved less expensive than provisions of a waste treatment plant.

Costs assignable to this part of the overall installation were about $330,000. It so happens that a substantial return, accounted for in part by the provision of the extra equipment installed for pollution abatement, is being realized on the overall investment. With the previous process and equipment, but at present day production rates, the B.O.D. from this operation alone would now be 9,500 lbs. per day.

Under previous conditions, and at present operating rates, the amount of sulfuric acid to the sewer would have been 83,000 pounds per day. It is obvious that such tremendous loads on a small stream would have been unbearable, even after neutralizing the acid. It is evident that continued operation of the plant depended upon keeping this acid waste at an acceptable level.

Another Process Change With Profit

Another process change involved the following. In the spinning of acetate rayon, acetone is evaporated from the thread. Some of this acetone was taken into air washing equipment where the water sprays washed acetone to the river. Although acetone is not a nasty pollutant, it consumed the dissolved oxygen of the river.

Alterations at an expenditure of $124,000 almost completely eliminates the acetone from the sewer and puts it back into the storage tanks at many thousands of dollars saved.

The bar at the side of Fig. 3 shows the total losses (before and after) from this section of the plant. They are now 37% of the previous amount.

The organic waste, principally from removal of finish from waste yarn has increased during the past few years, but the total quantity is so small that corrective measures have not yet been applied. This is true also of a small poundage of miscellaneous wastes.

Prevention vs. Cure

Looking back over these years' work, one must admit that progress has been made in a systematic fashion. In retrospect, it might be beneficial to consider what have been the elements of this success.

First, the fundamental philosophy has been that of "prevention," by working at the source to reduce the waste, rather than providing a "cure" at the end of the plant sewer. If the disposal approach had been taken in 1947 we would now have several acres of tanks and bio-filters, costing at least $1,500,000. Even assuming that these units would operate at 80% efficiency they would still leave as much, if not more, B.O.D. to be discharged as now, with thousands spent for the installation and its operation; and, without the savings now being realized. The big reductions in loss of materials are effected by use of an entirely different way or process, or different equipment. This is where plant management and technology, as distinguished from waste treatment, have gone all out in a really tremendous way to eliminate pollution. The approach of attempting savings at the source prior to correction through waste treatment seems to be too often overlooked. In some cases the pollution abatement agencies, in their zeal to get something done, foster this waste disposal philosophy and neglect the philosophy of intra-plant waste production. All that can be known at the start is that standard disposal methods will make some reduction. This is seemingly not the best approach, particularly from the far-

INSTRUMENTATION and recording at key points in the plant is an all-important factor in any waste curtailment program.

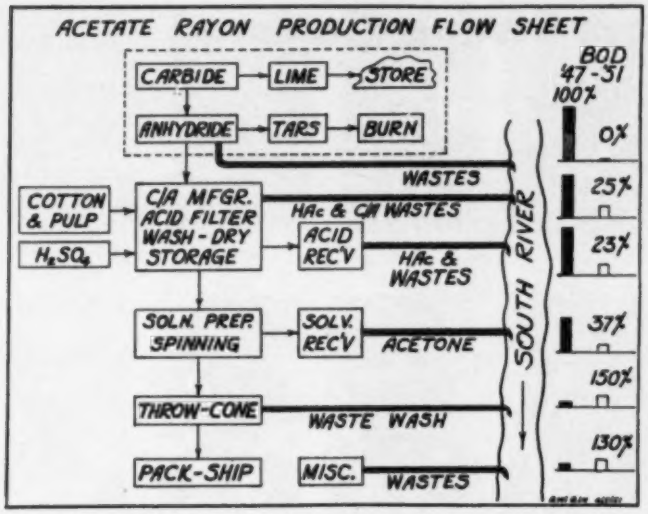

Fig. 3—PRODUCTION FLOW SHEET of the Waynesboro Plant showing the reductions in stream loadings from various manufacturing operations in terms of BOD.

sighted viewpoint in which corrective and preventative measures within the plant can be more soundly financed than can the construction and operation of waste treatment plants.

The policy of taking a single operation, drawing a line around it, and working on it to decrease the waste, is effective. One can not know whether a waste can be reduced at the source, let alone *how* it can be reduced, until its origin is carefully scrutinized.

A few years ago, it appeared that we needed a pilot plant to determine the best way to treat our waste. In a preliminary way we drew up our conception of such a plant which was rather elaborate and expensive. Then, instead of asking us to apply effort and money on studying and developing treatment procedures, the Virginia Water Control Board approved postponement of a pilot plant, while we directed our efforts at the source. The results speak for themselves.

The Value of a Sympathetic Top Management

A second element leading to the success of this program was the fact that our Du Pont Management really wanted pollution abatement. This appeared in the day-to-day attitudes such as willingness to spend money where necessary and the policy of holding the organization accountable as much for stream pollution as for production and costs.

In this connection it is our definite feeling that stream pollution abatement must be the responsibility of the plant operating group. To set up some special technical group to solve the pollution problem will not work. The technical group can lead and point the way, can measure and analyze, but the operating group must do the job of making pollution abatement wholly effective. The story of what needs to be done and what is being done must be gotten over to each member of the plant operating force. Management must have the cooperation and assistance of every operator and maintenance man. A large number of small losses add up to sizeable poundages.

Through cooperation of management, technology, maintenance and operating personnel, and an expenditure of one-half million dollars, but not without considerable savings, waste products at the Waynesboro Plant have been reduced to about one-fourth their previous level without the necessity of expensive treatment works.

WEIR AND SAMPLER on waste ditch from acid recovery operations.

A Worth Knowing Laundrying Kink

Where the water supply at consumers taps contains iron or manganese, the prevalently used liquid bleaches (caustic hypochlorite) in home laundrying will often cause mottling or streaking of white and light colored clothing and linens. This has been traced to the oxidation and precipitation of iron and manganese which the cloth absorbs during washing and rinsing.

Where this condition exists, one remedy advocated is to advise housewives to reverse the usual procedure and do their bleaching *before* washing. In this way, it is said, the cloth will not come out mottled or otherwise discolored from the precipitates of iron or manganese.

The explanation given is, even if the pre-wash bleaching does precipitate the oxides on the cloth the subsequent washing and rinsing will loosen and remove the precipitates mechanically.

This information, from a usually reliable source, may prove well worth knowing where iron or manganese gives trouble in home laundrying. Anyone had any experience?

NEWWA Favors Strong National Water Policy

70th Convention Breaks Attendance Record by One

A Report

by GEORGE E. SYMONS*, *Contributing Editor, and HARRY A. FABER***, *Editorial Associate, Water & Sewage Works*

Thos. R. Camp
Cons. Engr.
Boston,
Mass.
(Ret. Pres.)

F. O. A. Almquist
Prin. San. Engr.
St. H'lth Dept.
Hartford, Conn.
(President)

Stan. M. Dore
Dep. Ch. Engr.
Alleg. Co. Auth.
Pittsburgh, Pa.
(1st Vice Pres.)

Officers

W. B. Duffy
Supt.
Pub. Wks. Dept.
N. Andover, Mass.
(2nd Vice Pres.)

Wm. P. Melley
Comm.
Water Dept.
Milton, Mass.
(Treasurer)

Jos. C. Knox
Exec. Dir.
N.E. Compact
Boston, Mass.
(Secretary)

MEETING in Boston, Mass., on Sept. 10-12, the New England Water Works Assn. held its 70th Convention. Attendance reached a total of 753, thereby breaking the previous record by one. Outstanding features of the meeting were the adoption of a resolution on National Water Policy, a forthright address by retiring President Thomas R. Camp, Cons. Engr. of Boston, and a boat trip to Provincetown, Mass., on the tip of Cape Cod.

New Officers

This being the annual meeting, new officers were elected for the ensuing year. When the ballots had been tabulated, the following persons had been chosen.

President
Fred. A. O. Almquist,
Prin. San. Engr.
Conn. Dept. of Health
Hartford, Conn.

First Vice Pres.
Stanley M. Dore, Dep. Ch. Engr.
Allegheny County San. Authority
Pittsburgh, Pa.

Second Vice Pres.
William B. Duffy, Supt.
Public Works Dept.
No. Andover, Mass.

Directors
Roger G. Oakman, Supt.
Water Division
Needham, Mass.

Allan F. McAlary, Supt.
Camden-Rockland Water Co.
Rockland, Me.

Scott Keith, Engr.
Metcalf & Eddy
Boston, Mass.

Treasurer
William P. Melley, Comm.
Water Dept.
Milton, Mass.

Secretary
Jos. C. Knox, Chief Engr.
N.E. Interstate Comp. Comm.
Boston, Mass.

Editor of Journal
George C. Houser, Cons. Engr.
Brookline, Mass.

Honors and Awards

As is customary, following the annual dinner, at which active members are guests of the Wat. & Sew. Wks. Mfrs. Assn., honors and awards were conferred on several members of the association.

The DEXTER BRACKETT MEMORIAL MEDAL was presented Stanley M. Dore, Deputy Chief Engineer, Allegheny County Sanitary Authority, Pittsburgh, Pa. This award for the best paper published in the 1950 Journal was made to Mr. Dore for his paper titled, "Chicopee Valley Aqueduct."

The COMMEMORATIVE AWARD FOR 1950 was made in memory of Frank E. Winsor, late Ch. Engr., Met. Dist. Comm., and was presented to Walter H. Sears, Ret. Mech. Engr. of the Metropolitan District Comm., for his paper published in the Sept. 1950 Jour. NEWWA and titled "Damages Paid on Account of the Diversions from the Ware and Swift Rivers for Water Supply of the Boston Metropolitan District."

TWENTY-FIVE YEAR AWARDS, made annually to active members who have served one community for 25 years and have been members of the association for the same length of time, were presented to Harold L. Field, Engr. and Supt., Water Dept., Greenfield, Mass., and to Edward L. Randall, Supt., Water Dept., Wrentham, Mass.

HONORARY MEMBERSHIPS were presented to Theodore Bristol, Pres., Ansonia Water Co., Ansonia, Conn.; Richard H. Ellis, Hydraulic Engineer, Assoc. Factory Mutual Fire Ins. Cos.; and Warren J. Scott, Director, Bur. San. Engr., State Dept. of Health, Hartford, Conn.

The DIPLOMA of the Institution of Water Engineers of Great Britain awarded to a member of the NEWWA every four years for the best paper chosen for presentation before the Institution. This award was for the period 1947-50 and was presented to

*Consultant and Technical Editor, Larchmont, N.Y.

**Research Chemist, The Chlorine Institute, New York City.

Directors

Roy. G. Oakman
Supt.
Water Dept.
Needham, Mass.

A. F. McAlary
Supt.
Water Co.
Rockland, Me.

Scott Keith
Engr.
Metcalf & Eddy
Boston, Mass.

Honorary Members

Theo. Bristol
Pres.
Ansonia Water Co.
Ansonia, Conn.

W. J. Scott
Dir., San. Engr.
St. H'lth. Dept.
Hartford, Conn.

Rich. H. Ellis
Hyd. Engr.
Fact. Mut. Ins.
Boston, Mass.

Stanley M. Dore, Dep. Ch. Engr., Allegheny Co. San. Authority, Pittsburgh, Pa., for his paper published in the Mar. 1949 issue of the Journal and titled "An Inverted Siphon for the Assabet River Crossing of the Wachusett Aqueduct." Mr. Dore will go to England in the summer of 1952 to personally present the paper before the Institution.

Presidential Address

Highlight of the meeting was the presidential address by retiring President, Thos. R. Camp, Cons. Engr., Boston, Mass. Mr. Camp's forthright speech was on the subject of "FEDERAL BUREAUCRACY AND A FREE SOCIETY."

Emphasizing his concern over the trend toward state socialism in Federal Government, Mr. Camp said, "We must adopt early and continuous aggressive action if we are to save our way of life." Pointing out that this trend has been noticeable for several decades, particularly with federal handouts in the depression years and with accelerated government spending in World War II, Mr. Camp said that the trend threatens now to get entirely out of hand.

"Every new function of the Federal Government requires an appropriation and expenditures, and every new expenditure . . . requires additional personnel on the federal payroll." "Make no mistake about it," continued Mr. Camp, "it will cost us more to have Uncle Sam do something for us than it would cost us if we did it ourselves. Moreover, federal assistance on local or regional endeavors means federal control. We are losing our free-enterprise system, the rights of the states are seriously being impaired, and concurrently, our public morals are degenerating alarmingly."

Calling attention to a report on "The New England Economy" by the Committee on New England Economy of the President's Council of Economic Advisors, wherein it was recommended that New England submit to the "trend of the times" and accept federal handouts and control, Mr. Camp said that this attitude was cowardly and viscious. "If the federal operation is clearly for the benefit of all people and has economic justification, we should support it. If, on the other hand, the federal operation is clearly unsound, we should not only refuse our share of the handout, but should also do all in our power to stop the operation altogether."

By means of a graph, Mr. Camp showed some startling trends in the national economy. Although there has been a 3.2 fold increase in national income dollar value since 1938, the commodity price index has increased 2.3 fold. In other words, the dollar today is worth only 43 cents compared to 1938 and the actual increase in national income is only 40 per cent not 320 per cent.

Mr. Camp's graph also showed the enormous increase in federal debt and strangely enough, the almost proportional increase in federal employees. State and local debt, during this period, increased very little, despite the decrease in the value of the dollar. Private debt on the other hand, has increased about 60 per cent or more than enough to compensate for the decrease in the value of the dollar. These data point to the fact that state and local government is permitting the federal government to pay for public works, which should be financed locally.

"All signs point to another substantial increase in our national debt because of the troubled international situation. Another world war will pile debt still higher." While we do not know how large a federal debt we can stand, we do know that our resources are not inexhaustible, according to Mr. Camp, who also pointed out that present inflation has meant that persons who invested in government bonds in World War II have lost 57 per cent of their investment.

Mr. Camp concluded his address with a plea that water works men exert their influence to refuse to accept federal handouts, where such are uneconomical and rob the state, regional, and local governments of autonomy. He also entered his plea for the support of a fair minded national water policy which will preserve the rights and powers of local government.

National Water Policy

Not only President Camp, but the Committee on Conservation, Development and Utilization of Water Resources was concerned with the subject of National Water Policy. This committee had studied federal legislation in connection with water resources, had reviewed the report of the Engineer's Joint Council on the subject and had reviewed the activities of the National Water Conservation Conference which, representing 42 states, is cooperating to promote local and state

NEWWA

(Asst. Secy.)
Alice Melrose
NEWWA
Boston

(President)
Robt. F. Orth
Johns-Manville
New York

W. S. W. Mfrs. Assn.

(Secy.)
Dorothy Dimmers
W. & S. W.M.A.
New York

(Manager)
John Stewart
W. & S. W.M.A.
New York

Entertainment

Wm. P. Brenchick
Engr.
Johns-Manville
Boston, Mass.

H. W. Griswold
Cons. Engr.
Water Bur.
Hartford, Conn.

R. C. Hawley
Forester
N.H. Water Co.
New Haven, Conn.

Forestry Practices

P. A. Shaw
Supt. & Engr.
Water Works
Manchester, N.H.

Frank Hubbel
Bridgeport
Hydraulic Co.
Bridgeport, Conn.

Irv. Hart
Forester
Water Bur.
Hartford, Conn.

participation in plans for water resources development and the development of a sound national land and water policy.

Based on its study of the current situation, wherein the Federal Bureau of the Budget appears to be rewriting the report to the President by the Engineers Joint Council, the above named committee of NEWWA presented a resolution to the assembled meeting. After reading the committee report, which reviewed the considerations of the committee, the following resolution was presented to the business session of the annual meeting:

"WHEREAS legislation is being proposed in the Congress to implement a National Water Policy and whereas the members of the New England Water Works Association are vitally concerned with water policy.

"BE IT RESOLVED that the New England Water Works Association favors a National Water Policy which will lead to an economic development of the nation's water resources with collective action for management and payment of the costs at the lowest governmental level practicable for each development, and with due regard to the possibilities of interstate cooperative action.

"BE IT RESOLVED that the Federal Government should engage in the conservation and control of water resources only when the collective action of all of the people of the nation is necessary for accomplishment of the objective, or when the benefits accrue to all of the people of the nation, and

"BE IT FURTHER RESOLVED that the Federal Government should participate in water resource development primarily in a fact-finding and advisory capacity.

"The Executive Committee of the New England Water Works Association is hereby directed and empowered to take action for the Association consistent with this resolve."

The resolution was unanimously adopted.

Business Session

During the annual business session, the Secretary reported that the membership of the Association had once again passed 1000 with a goodly number of applications on file for approval. For the first time, the Association had actually operated at a deficit, although it had been adopting a deficit budget for several years. This deficit was less than $800 and was caused by the publication of the Index to the Journal for the years 1882 to 1950. The association again adopted a deficit budget, but with the increase in membership and advertising in the Journal, it seems unlikely that actual operations will be in the red, even though publishing costs for the Journal have risen from $3400 in 1934 to $6420 in 1951.

During the year, two committees were discontinued, one inactivated, two discharged, and two created. Twelve committees presented reports. One report of particular interest was that of the Legislative Committee which reported on activities in the several state legislatures.

LLOYD NELSON (of U.S. Pipe and Fdry. Co.), Consultant to the Water Resources Division of the National Production Authority asked for cooperation in the filing of requests by filling in sufficient detail about materials needed. Mr. Nelson said that superintendents must rate their own orders. He has hopes that the construction value minimum for which ratings must be given will be raised to $50,000 instead of the now ridiculously low figure. Nelson also spoke on efforts being made to avoid the cut in production of filter alum by 30 per cent. He believes that sufficient sulfur will be set aside for sulfur joint compounds, particularly inasmuch such jointing compounds eliminate the need for lead which is a critical material.

Symposium on Fluoridation

President Thomas R. Camp presided at the "Symposium on Fluoridation" which comprised the entire afternoon technical session on the first day of the convention. Three prepared papers were presented and the meeting was opened to general discussion from the floor.

"FUNDAMENTALS OF WATER FLUORIDATION" by Harry A. Faber, Research Chemist, The Chlorine Institute, Inc., New York, N.Y.

In order to provide background for the discussion, Mr. Faber discussed water fluoridation practice and philosophy in terms of five particularly significant facts.

Fluorides are a natural constituent of water. To illustrate this first fact, he cited a study of the distribution of

Reg. Hayes; Chas Dearborn
"Hydrotile" *"Transite" Pipe*

Bob Orth
Mrs. Dan Saunders

Mrs. Carlton; Mrs. Mann;
Leland Carlton

The John Stewarts

Mrs. "Bob" Orth
Mrs. "Reg." Hayes

On the Provincetown Boat

Programmers

H. Burgi, Jr.
Gen. Mgr.
Port. Wat. Dist.
Portland, Me.

W. L. Picton
W. & S. Advisor
Def. Prod. Auth.
Washington, D.C.

H. A. Faber
Res. Chem.
Chlor. Inst.
New York City

F. W. Gilcreas
Asst. Dir. Labs.
St. H'lth Dept.
Albany, N.Y.

Lloyd Nelson
Consultant
Wat. Res. Dir.
Nat. Prod. Auth.

Geo. W. Woods
Ch. Engr.
Bd. Wat. Comm.
New Britain, Conn.

natural supplies containing from 1.0 ppm. to more than 5 ppm. fluoride ion; located mostly in Ohio, Indiana, Illinois, South Dakota, and Texas; and serving about three million people. Lantern slides illustrated the appearance of mottled enamel and the severity of fluorosis in relation to the fluoride content of the water supply.

Nature has conducted a scientific experiment. This second fact was illustrated by reviewing data conclusively establishing the inverse ratio existing between dental caries (tooth decay) and the fluoride content of the water consumed.

Fluoridation is man's imitation of nature. The third fact summarizes experimental and empirical installations for fluoride treatment of water supplies deficient in natural fluorides. Recent data were cited revealing that a total of 103 communities in 25 states are now using this treatment (the number of communities which have received approval for fluoridation and are now installing equipment will bring the total to more than 200 installations).

New problems of operation are involved in fluoridation. These problems involve feeding equipment, toxicity considerations, and the determination of residual fluoride ion. In addition, the question of chemical availability was reviewed.

New problems of philosophy are involved in fluoridation. The practice should clearly be termed "supplemental treatment," since it is specifically the adjustment of the fluoride content of water to the optimum level. Questions relating to good results, harmful results, and cost of the practice were briefly discussed. Philosophical considerations were reviewed, and the attitude of the AWWA toward the practice was emphasized.

Lantern slides showed graphically the reductions in DMF rates which had been shown to follow the continuing practice of fluoridation in controlled experimental studies. Comparative data were shown illustrating rates before and 4 to 5 years after the supplemental treatment at Grand Rapids, Newburgh, and Brantford—the three cities where this practice has been in use since 1945.

"Fluoridation Experience in New Britain, Conn.," by George W. Woods, Chief Engineer, Board of Water Commissioners, New Britain, Conn.

Mr. Woods admitted he had been more difficult to convince that New Britain should adopt fluoridation than had the members of the city council. The local health officer recommended its adoption early in 1949 and, after receiving the approval of the State Department of Health, installation of equipment was started in March of 1950. This was in operation in December of the same year, but continuous treatment started in April of 1951.

An average flow of 9.5 mgd. is treated at New Britain, serving a population of 80,000. This involves treatment of three surface supplies at the filter plant where all are brought together. One other supply, a well water separately treated by chlorination only, is yet to receive fluoridation treatment. The equipment and chemical storage is segregated for control of dust, and operators are provided with respirators and rubber gloves. Sodium fluoride is the chemical employed, treating to maintain a 1.0 ppm. fluoride ion concentration in the distribution system. Water samples are tested both locally and by the State Dept. of Health laboratories.

Cost data were cited for the chemical dry feed equipment (2 units) and its installation ($5,000). There are no additional labor charges. Delivered cost (to the plant) of sodium fluoride is 12.25 cents per pound, and the cost of chemical is thus about 11 cents per capita per year. No special operating or testing difficulties have been encountered.

"Progress and Experience with Fluoridation of Connecticut Water Supplies," by Warren J. Scott, Director, Bureau of Sanitary Engineering, Conn. State Dept. of Health, Hartford, Conn.

Fluoridation studies in Connecticut started in 1945, Mr. Scott pointed out, with its controlled investigation at the Southbury State Training School. Municipal water works officials, despite the urging of the State Dept. of Health and the State Dental Society, have been slow to act. No appreciable concentration of fluoride has been found in natural waters of the state.

Of Connecticut's 109 public water supplies, 27 are owned by municipalities or municipal districts and 82 are owned by private companies or individuals. Plans have not yet been developed for financing fluoridation, but these are under consideration.

Another installation for fluoride treatment was made in November

Some of the 320 Voyagers

Including the Roger Oakman family in center and the "Fred" Almquists (New Preny) and Mrs. "Jo" (Secy.) Knox, right center. If the three ladies on left-center would remove their dark glasses we might be able to identify them.

And More Voyagers

Past Pres. and Mrs. "Dan" Calderwood | *Alice Melrose and the "Scotty" Marshalls* | *The "Steve" Taylors and Mrs. Roger Esty* | *"Herb" Croswell, Geo. Woods and "Friends"* | *Mrs. "Ernie" Tankard, Jim Crippen, "Gerry" Manahan*

1950 at the Mansfield State Training School. This installation, like that at the Southbury School, involves the application of sodium fluoride solution by means of chemical feed pumps into water from wells. The average daily water pumpage in each location is about 0.2 mg.

The first municipal installation in the state was that at New Britain in 1950, already described. A second has been made at the supply of the Cromwell Fire District, and is the first to employ a "saturator" for preparing a standard strength of fluoride solution, and a chemical feed pump for application.

Mr. Scott's Bureau has established certain requirements affecting installation, operation, and safety measures relating to the fluoridation of public water supplies. Experience indicated that average annual costs will range from about 10 cents to 20 cents per capita per year, including all items. In isolated cases where special factors exist, costs may be as high as 35 or 40 cents per capita per year.

A bill was introduced into the 1951 Assembly to make water fluoridation compulsory; it did not pass, but has been referred to a Legislative Council for recommendation to the next session of the Assembly in 1953. Mr. Scott considers fluoridation to constitute a growing and economical dental health program.

In answer to questions, Dr. Erlenbach of the State Dept. of Dental Health strongly recommended water fluoridation as against topical treatment for its greater and more universal effectiveness. Its value must be recognized in comparison with the cost of filling teeth, and prevention is far more successful than correcting defects after they have occurred.

Superintendents' Round Table

This regular feature session was presided over by Past President Harold Griswold, Cons. Engr., Hartford, Conn., who conducted a panel discussion of FORESTRY PRACTICE AND WATER WATERSHED MANAGEMENT.

Forestry

Mr. Griswold opened the discussion by commenting that water works lands have the primary function of being used for water supply and not for subsidiary business. With modern water treatment, however, it appears that these lands may also be put to other uses, as long as areas are protected against public inroads.

Timbering and forestry are the simplest means for increasing income from watershed lands, but the actual practice of forestry is not as simple as it sounds; it needs attention from planting through care to final cutting and disposal of the timber.

"GENERAL FORESTRY PRACTICES" by Prof. Ralph C. Hawley, Forester, New Haven Water Co., New Haven, Conn.

Prof. Hawley gave a brief summary of the activities essential for forestry practice by a water board. Holdings must be surveyed, plantings made and care given to the timbered lands. Any forestry program needs an outlay of cash for planting and labor, but this will be justified as protection to the watershed. Later it will actually give a return on the investment. Good forestry management is an essential to proper operation of a forestry project. The cutting program is important and must be done properly according to good forestry practice.

Prof. Hawley also explained cutting by piecework basis and cutting by stumpage and the financial advantages of each method. One of the big problems in many cases is to make use of day labor in off seasons and to do so by using it in forestry operations. Generally, this is not the most economical means of operation as far as forestry operations are concerned but may be for the water works operations as a whole.

"SAWMILL OPERATION AND MARKETING FOREST PRODUCTS" by Percy A. Shaw, Supt. of Engr., Water Works, Manchester, N.H.

Plantings on Manchester Water Works property have been made for the past 40 years, plus experimental areas. Mr. Shaw said his department now cuts about 500,000 board feet a year. They have their own sawmill which he described both as to present remodeled construction and as to operation.

According to Mr. Shaw, good sawmilling begins with the selection of the proper trees for cutting; trees that will produce the most logs and then in turn will produce the best grade of lumber. He believes that the stumpage price is better than piece work for cutting operations. Nearly all of the profit on this watershed is made in the mill and it adequately pays for all cultural work, weeding, pruning, etc. Good marketing is an important factor in high return.

"FRUIT RAISING ON WATERSHEDS" by Franklin Hubbell, Bridgeport Hydraulic Co., Bridgeport Co.

Mr. Hubbell said that his company's operations were frankly for profit. He described the areas where fruit trees are grown and told how the orchards were divided, cultivated, and harvested. Little logging is done, except for blowdowns, but in addition to fruit, evergreen trees are raised for the Christmas tree market and for sale to Westchester County for parkway plantings and to individuals.

Dinner at the Flagship and Scenes Aboard

The Manns and the Orths. | *Scott, Dore, Kennison, Knox* | *Charlie Crump and the Poker Gang.* | *Kennison, Anthony, Camp and "Friend"* | *The Rockwell Party.*

Relaxing During 3 hr. 35 min. Trip

Kent Clow of Chicago and Friends — *The Roy Evans* — *"Theo" Bristol (Hon. Mem.) and Mrs. B.* — *The Mark Sheridans Chicago Meter Div.* — *Some nice ladies —but who?*

A packing plant and cold storage warehouse is part of the project and the department makes its own apple boxes from its logging operations. They also utilize pine trimmings for making shavings. One of the problems encountered in the forests is a new insect disease of the red pines.

"TREATING FENCE POSTS" by Irving Hart, Forester, Water Bureau, Metropolitan District, Hartford, Conn.

Mr. Hart described methods of treating fence posts to prevent rot. This preservative treatment is best using cresote under pressure, but for the small operator there are two other methods; a water soluble treatment with zinc chloride under pressure or an oil soluble treatment with pentachlorphenol or copper naphthenate. Mr. Hart gave the details of the latter treatment explaining time elements, bath concentrations, penetration, etc.

Portland, Me. Construction

"RECENT CONSTRUCTION OF THE PORTLAND WATER DISTRICT" by Herman Burgi, Jr., Treas., and Gen. Mgr., Portland Water District, Portland, Me.

Mr. Burgi, with the aid of a map, described construction problems and difficulties including tunnelling under the Maine Turnpike. He also told of replacing certain lines and of the ruling by the Public Service Commission that the District had to put in a 8-in. line for $41,000 to serve a very small area at an annual return of only $200. One of the lines removed was of the old "Stove Pipe" type; i.e., a thin steel shell with thin cement casing both outside and inside. The pipe was still good but it would not take modern taps without leaking. Altogether, 39,000 ft. of main were installed.

CMP for Water Works

"HIGHLIGHTS OF CURRENT CONTROLLED MATERIALS PLAN FOR WATER WORKS CONSTRUCTION" by Walter L. Picton, Water and Sewage Works Advisor, Office of Program and Requirements, Defense Production Authority, Washington, D.C.

Mr. Picton reviewed the history of the Controlled Materials Plan as it had operated in World War II and stressed the importance of water supply. Much of the deferred maintenance of that war still exists or is still affecting operations of water supplies throughout the country. On top of that condition, we now have a shortage of materials.

The speaker explained what has happened to make certain materials short and the competition between defense needs and civilian needs. He also discussed the use and allocation of key materials, how the requirements agency works, the part claimant agencies play in procurement and how the whole picture should be more in balance by 1953.

Before answering a number of questions from the floor, Mr. Picton urged water works men to cooperate with the Water Resources Division in its efforts to make the whole program work to the benefit of the water supply industry and the country at large. Among the questions asked were the following:

Q. by PETER KARALEKAS, Chief Engr., Springfield, Mass.—Can prices be set for a contractor? A.—Not yet.

Q. by L. F. DUTTON, Supt. Groton, Conn.—If a sub-division is planned by the Federal Housing Authority is it the Fed. Govt. responsibility to make the application for needed materials or is it the responsibility of the water dept. A.—It is the responsibility of the water department to make the application through the Water Resources Division for all material up to the lot line.

Q. by ROBT. F. ORTH, Pres. Wat. & Sew. Wks. Mfrs. Assn.—Some manufacturers are not covered by CMP D.O. Ratings on military and defense needs; can the manufacturer work through the Water Resources Division and appeal for allotments between defense and civilian needs. A—This will be ironed out when D.O.'s just reach the equivalent of the production of the manufacturer; the problem is also concerned with the A Products List versus the B Products List.

Q. by ARTHUR SHAW, Metcalf and Eddy, Cons. Engrs., Boston, Mass.—Why must a community apply over and over again if their application is not granted in any particular quarter; why can't that application merely be transferred to the next quarter with making it necessary to reapply. A—It is hoped that this will be avoided by revising the rules, but for the present it appears necessary. It will help if the deadline for the project is included in every project application.

Civilian Defense

"CIVILIAN DEFENSE OF NEW ENGLAND—RECENT DEVELOPMENTS" by Albert D. O'Conner, New England Regional Developments, Federal Civil Defense Administration, Boston, Mass.

Mr. O'Conner pointed out that the Defense Administration is definitely in business and must continue so because: (1) The United States is menaced by Russia, (2) National defense against Russia is necessary and (3) National defense consists of Army, Navy, Marines, and Air Force plus Civilian Defense of the Home Front.

Flash Gun Shots

Mrs. Camp & Pres. Camp at dinner; Dexter Brackett Medal to Stan Dore; the smiling Irishman, Johnny O'Reilly of Hersey Meter; cocktail party with Carl Browns, right; Pres. & Secy. ponder Nat. Wat. Policy.

—Military defense alone cannot protect the home front.

Mr. O'Conner described the development of Civilian Defense and how it works. He presented some topics of specific nature applicable to the operation of water supplies and called attention to Bulletin TM-9-1 of the Federal Civil Defense Administration titled "Water Supplies for Wartime Fire Fighting."

Wonders of Water

H. R. Walrath, General Electric Co., Schenectady, N.Y. presented the world premier of the new motion picture produced by G.E., namely, "THE WONDERS OF WATER." This was an extra added attraction, not scheduled on the program. The picture, part of the Water Supply Program of G.E.'s "More Power to America Program." This motion picture is a sequel to "Clean Waters"; it deals with problem of water supply, how it is obtained, how it reaches the public, how it is treated, and the many ways in which water supply is so essential to modern life as well as modern industry.

This film, which is well worth seeing by both water works men and the general public, is available for loan through any local G.E. Representative of the Apparatus Division. With the loan of the film goes a minimum number of a Manual titled "Good Water and Plenty of It" and a supply of handouts titled "The Wonders of Water." Water departments or companies faced with selling a program to a municipality may also obtain the film for use in its program by buying a print for $170, the cost of the print. A supply of manuals and of handouts goes with the purchased film print.

Standard Methods

"LIMITATIONS OF STANDARD METHODS FOR EVALUATING SANITARY QUALITY OF WATER" by F. W. Gilcreas, Asst. Dir. in Charge of Laboratories for Sanitary and Analytical Chemistry, N.Y. State Dept. of Health, Albany, N.Y.

Mr. Gilcreas' paper referred only to bacteriological tests and began by reviewing the history of *"Standard Methods for the Examination of Water and Sewage."* Mr. Gilcreas pointed out that the first Edition of "Standard Methods" presented only tentative methods; the latest edition also presents provisional methods. While much more is now known about bacteriological tests and the organisms involved in the contamination of water, even today's methods cannot be accepted as the final word in analysis. More and more research needs to be done.

Some investigators believe the definition of the coliform group is still too inclusive. Others think there should be a restriction on the time between sampling and analysis should be more restrictive. The completed test has been dropped from the routine, but there still remains the fact that the coliform group is only an indicator organism and is not positive proof of pollution. Differentiation between Escherichia Coli and Aerobacter Aerogenes is too long and too complicated and yet the meaning of the Aerogenes in water supply contamination is not fully understood or defined.

Then there is the problem of the non-lactose fermenters, and the slow fermenters and what they signify. Just what is the significance of the Most Probable Number has not been fully established, and the determination of viruses is still impossible in water analysis. The significance of the plate count has been relegated to a lesser position as more has been learned about it. The new plate count will be made at 35 deg. C.

Although the U.S. P.H.S. has recently released news stories on its method of microfilters, the method has not been officially reported and will therefore, not be included, even as a tentative method in the 10th Edition of "Standard Methods." Mr. Gilcreas called for work to begin on the 11th Edition now, even as the 10th Edition is being prepared for the printer. The 10th Ed. may be expected sometime next year.

Cambridge Water Supply

"RECENT DEVELOPMENTS—CAMBRIDGE WATER SUPPLY" by Howard M. Turner, Cons. Engr., Boston, Mass.

Mr. Turner reviewed the history of the Cambridge Water Supply before presenting a description of the most recent developments of that supply.

Entertainment

Entertainment for the assembled registrants and their wives consisted of a boat trip (3 hr. and 35 min. each way) from Boston to Provincetown, Mass. (on the tip of Cape Cod), as well as a dance following the annual dinner, which was preceded by a cocktail party. A bus trip through historic Boston and Cambridge and a style show and Canasta Party were special functions for the ladies.

Over $293,000,000 to be Spent for Water & Sewage Facilities in Next Few Years

According to a recent report from the Housing and Home Finance Agency, Washington, D.C., the estimated expenditures for new water and sewage facilities and additions to existing facilities, for which planning funds have been advanced, will total $293,984,000 or more over the next few years.

These total figures cover 392 sewer facilities and 122 water facilities and include the estimated cost of land and right of way; construction; equipment; plan preparation and other costs.

These figures indicate only those facilities for which advances for plan preparation have been approved under the Second Advance Planning Program for Non-Federal Public Works, as of December 31, 1950.

The amount of $250,227,000 that will be spent for sewage facilities breaks down as follows:

Land & right of way	$ 3,282,000
Construction	212,236,000
Equipment	12,502,000
Plan preparation	8,422,000
Other	13,786,000
Total for sewage facilities	$250,227,000

The amount of $43,757,000 that will be spent for water facilities breaks down as follows:

Land & right of way	$ 1,710,000
Construction	37,443,000
Equipment	986,000
Plan preparation	1,510,000
Other	2,107,000
Total for water facilities	$ 43,757,000

The above breakdowns show that a total of $13,488,000 will be spent for new equipment in the water and sewage works field in the next few years.

In addition to this contemplated expenditure of $293,984,000 for water and sewage facilities, the plans for which have been financed through this Federal agency (HFA), there must be considered many additional projects for which Federal planning monies have not been, and will not be, applied for. Also there must be considered those facilities to be provided by privately owned water utilities, and by industry for water supply and waste disposal projects.

Steel-like Men

Most men are like steel—namely, of little use when loosing temper.

Meet Our New Editor

WITH considerable pleasure and pride we announce that on January 1st Harry A. Faber will join us as the new Associate Editor of *Water & Sewage Works*.

To our regular readers Mr. Faber will need no introduction, since he has been a consistent and valued contributor of articles and reporter of technical meetings in *Water & Sewage Works* for a number of years. For some time his name has appeared on our masthead as Editorial Associate, and now he becomes full time Associate Editor.

Mr. Faber's education and experience have been consistently related to the field of water, sewage, and industrial waste treatment. His interest in sanitation began during his high school years when employed as laboratory assistant at the plant of the Consolidated Water Co., of Utica, N. Y. He is a graduate of Cornell University, from which he received the degree of A.B. in Chemistry in 1930—specializing in sanitary chemistry and completing courses in biology, limnology, and bacteriology.

At Cornell University, for three years, he served as instructor in Sanitary Chemistry and superintendent of the university's water filtration plant, while pursuing graduate courses in sanitary engineering. During this period, he acted as consultant on stream pollution problems for the Department of Health and Department of Conservation of New York State. During the next two years, as bio-chemist for the Consolidated Water Co., he made special studies of chlorine-ammonia treatment for the control of slime organisms in long transmission pipe lines. These studies came to the attention of the Chlorine Institute, Inc., New York, which offered him the position of Research Chemist in 1935.

In his sixteen years as Research Chemist for the Chlorine Institute, Mr. Faber has made a number of original contributions to the application of chlorine in treatment of water, sewage and industrial wastes. His review of superchlorination practices in North America, in 1939, led to a re-evaluation of the chlorination process and to the present concept of free residual chlorination. He assisted in the development of the hypochlorite process for treatment of wool scouring wastes, and suggested basic principles of the chlor-alkali method for oxidation of cyanides in industrial wastes.

Mr. Faber has become widely and favorably known for technical papers presented at meetings of water, sewage, and industrial waste associations in the U. S. and Canada. He participated in many schools for plant operators, discussing new chlorination practices and advancing the safe handling of chlorine. He visited a large number of water and waste treatment plants, and assisted plant authorities and consulting engineers in experimental studies of new applications of chlorine.

He is the author of papers which have been published by technical journals in the U. S., Canada, England, and Mexico; he is a co-author of the book "Elements of Sanitation;" he assisted in the preparation of the AWWA manual of "Water Quality and Treatment;" and is a member of the FS & IWA committee which prepared the new practice manual "Chlorination of Sewage and Industrial Wastes." He edited the "Chlorine Manual" published by the Chlorine Institute.

The American Water Works Assn. in 1948 honored Mr. Faber by voting him its John M. Diven Medal in recognition of his contributions toward better understanding of water chlorination practices. In 1949, he was a recipient of the Association's Goodell Prize—as one of a committee which developed an outstanding report on "The Fluoridation of Public Water Supplies." He is the AWWA representative on the Joint Editorial Board for the tenth edition of "Standard Methods for Examination of Water, Sewage, and Industrial Wastes."

Mr. Faber is an active member of several committees of the FS & IWA, and is chairman of the program committee of the New York State Sewage and Industrial Wastes Assn. He is also a member of the American Public Health Assn., the American Chemical Society, and of Sigma Xi honorary research fraternity.

Fluoride Feeding*

by L. E. HARPER, *President, Omega Machine Co., Providence, R.I.*

FLUORIDATION of public water supplies to obtain a reduction of dental caries for consumers has been the subject of much study since the Newburgh-Kingston experiments were started. Interest has increased as the favorable results of this and other controlled experiments at Grand Rapids, Sheboygan, Evanston and other cities have been published. The subject has been well covered from chemical, biological, legal, ethical and cost standpoints, particularly in recent papers by Maier[1] and Faber[2]. This discussion is devoted exclusively to the physical plant and the practical problems involved in fluoridation.

There is no single chemical or system of handling and feeding fluoride compounds that is best for all conditions and all sizes of plants. The equipment and chemical recommended depends on the size of the plant, whether or not the supply is enclosed and under pressure at the point of application (as in most small well supplies), the number of application points, the cost of fluoride compounds in the particular locality, whether or not the installation is planned for an existing or new plant and personal preferences.

Fluoride Compounds

Appended to this paper is some basic data for the sodium silicofluoride, sodium fluoride and hydrofluosilicic acid. This information is essential to provide an understanding of the handling and feeding of these materials.

Table 1 shows the characteristics of the most generally used fluoride compounds and their prices as of June 1951.

Table 2 shows the cost per year, for chemicals only, to increase the fluoride content 1 ppm. in plants of capacities from 0.1 to 10 mgd. Costs for intermediate or larger capacities may be obtained by using the value for 1 mgd. and the proper multipliers.

Table 3 lists the chemical companies which produce the three basic fluoridation chemicals. It will be noted that the new chemical "Flural*" ($AlFSO_4$) is not included in these tables, for the reason that its use is still under laboratory study.

Basic Installation Requirements

A quick glance at Table 1 may evoke the question, "Why use any but the cheapest chemical—silicofluoride?" For economic reasons, large cities should obviously not consider the more expensive forms. For the small plant, however, several factors such as equipment cost, desirability of using proportioning pumps for pressure feeding, distance from source of supply and space available for equipment affect the choice of compounds.

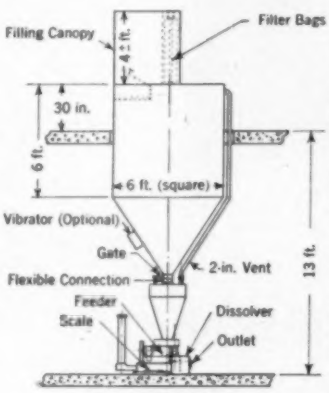

Fig. 1—Chemical Feeder and Storage Hopper

The hopper is installed above the feeder to save storage space. Although only 36 sq. ft. of floor space is used, approximately half a carload of fluoride compound can be placed in hopper.

Another factor is the current shortage of silicofluoride, although there will eventually be enough, as there are ample sources.

A very small plant can naturally afford to be less concerned with the price of the chemical than with the purchase and maintenance costs of the equipment required to apply it. In a very small plant the handling problem is also minimized. Although it is ideal to have handling made convenient in the smaller plants, it must be agreed that the time and attention given to this portion of the planning may be secondary. A small plant may use only 100 lb. of fluoride compound per month. If this 100-lb. container must be carried up a flight of stairs once a month the onerous task may not be desirable, but it is certainly not comparable to the hardship in a plant where the feeding rate may be several hundred pounds daily, or even 100 lb. per day.

Space Limitations

The majority of fluoride installations to be provided in the next several years will be constructed in existing plants which were built before fluoridation was ever known. In these it may be difficult to provide an ideal installation in these plants, simply because of space limitations. In planning fluoride feeder installations, as in any similar engineering problem, some compromise between the ideal and the practicable is frequently necessary. The recommendations in this paper are based on what has proved to be the best practice. The closer these precepts are followed, the better the installation will be—the more they are disregarded or compromised, the poorer the installation will be. It is not implied that an installation that fails to comply with these recommendations will not necessarily work. A workable installation may indeed be obtained if every suggestion offered here is ignored. It will, however, be a marginally operating installation, plagued by high maintenance costs, labor and material wastes, and improper dosing.

Factors Governing Choice

After chemical costs and basic physical requirements are considered, it is desirable to evaluate the types of installations which may be chosen.

A fluoridation installation must be viewed as an entity and examined in all its aspects. The best installation may be defined as one that has the best combination of the following factors:

1. Simple mechanical feeding device, either liquid or dry.

* A paper read before the New York and Ohio Sections of AWWA, here published by permission of the Association.

* An experimental product of Ozark-Mahoning Co., Tulsa, Okla. Flural has the appearance of granular alum and is intended to be fed in an alum feeder. The fluoride content can be adjusted relative to the alum content so that normal alum treatment of any water will give proper fluoride dosage. A second alum feeder for standard alum should be used during periods of greater requirements. Flural is said to be cheaper than alum plus sodium fluoride.

Table 1
CHARACTERISTICS OF FLUORIDE COMPOUNDS
(By Maier*)

Chemical	Formula	Purity per cent	F Content per cent	Solubility at 25° C. g./100 ml.	Cost per lb.	Cost per lb. Available F	1 ppm. F Treatment of 1 mil.gal.	
					crats		Cost dollars	Quantity lb.
Sodium Silicofluoride	Na_2SiF_6	98.5	60.0	0.762	5.6	9.33	0.78	14.7
Sodium Fluoride	NaF	98.0	44.4	4.050	11.0	25.0 (28.0 coarse)	2.09	19.5
Hydrofluosilicic Acid*	H_2SiF_6	30.0	23.7	Liquid	7.8	32.90	2.74	36.3

* Competent authorities state that hydrofluosilicic acid can be recovered as a byproduct of superphosphate fertilizer manufacture, at a cost competitive with silicofluoride when sold in tank car lots on a long contract basis. There is none available at present.

2. Simple piping or injection arrangement.

3. Minimum chemical handling.

4. Minimum maintenance and operational duties.

5. Minimum equipment expenditure consistent with good performance.

6. Means for maintaining a reliable permanent record.

Types of Installations

The various systems or types of installations available are listed below, with their advantages and limitations. The six conditions mentioned above must be considered in evaluating the suitability of these systems for any particular plant. Chemical cost is not a factor in this listing, although it does affect one's viewpoint. Simplicity is the watchword.

(1.) Rubber or plastic diaphragm type proportioning pump, delivering hydrofluosilicic acid by gravity directly from the acid container on scales to the point of application.

This type of installation requires minimum chemical handling. Diaphragm proportioning pumps are generally preferable to piston or plunger type pumps because of their lower maintenance requirements and greater simplicity. They will pump against 100 psi. but are limited to a capacity of approximately 7½ gph. for a single unit, or 15 gph. for a duplex pump.

Treatment with 7 gal. of fluosilicic acid will add 1 ppm. of fluoride ion to approximately 2 mil. gal. of water. Hydrofluosilicic acid or solution feeding is presently confined to the smaller plants or places at which feeding against pressure is necessary. Should cost of the acid come down, however, it might be purchased in carload lots and pumped to storage. A diaphragm pump or dipper type liquid feeder could then be used to measure the acid to the point of application. This could result in minimum chemical handling and a very simple installation. At present, existing customers are using all the fluosilicic acid produced.

(2.) Dry Feeder (on platform scale, or gravimetric weighing dry feeder) with dissolver, delivering sodium fluoride or silicofluoride solution by gravity to point of application.

Fig. 2. Dust Canopy
To prevent dust escape, bags or barrels of chemical are enclosed by housing while being emptied into hopper.

Dry feeders are ordinarily used in most medium- and large-sized plants, or wherever gravity feed can be used. Volumetric feeders will deliver as little as 3 to 4 oz. per hour to treat supplies of 200,000 gal. or more daily. Gravimetric (weighing) dry feeders will feed as little as 1 lb. per hour but are generally used for rates of more than 5 lb. per hour or to treat supplies of 5 mil. gal. or more daily.

(3.) Diaphragm type proportioning pump for hydrofluosilicic acid, delivering directly from acid container on a platform scale to main, under pressure, through an injection nozzle.

If calcium and magnesium are present, they may deposit on and clog the nozzle, thereby further complicating high-pressure injection. Pressure-feeding always involves additional equipment and more extensive maintenance than is required by gravity feed.

(4a.) Saturators for sodium fluoride with liquid feeder for gravity feed.

Saturators have many advantages that favor their use in plants in which this system is applicable. The tanks may be placed at a low level to facilitate filling, and they may hold a comparatively large quantity of chemical. An entire 100-lb. bag or 125-lb. drum may be added at one filling. The granular sodium fluoride used in them is quite free from dust.

A saturator with a proportioning pump that uses a 4 per cent solution will treat 3 mgd. with 1 ppm. of fluoride. Duplex or triplex proportioning pumps can double or triple this capacity.

(4b.) Saturators for sodium fluoride with proportioning pumps for pressure feeding.

If hard water is encountered, the saturator makeup water must be softened thereby complicating the installation and increasing maintenance.

(5.) Dry feeders (on platform scales or gravimetric) with injector or pump to deliver against pressure.

If hard water is encountered, ejectors, or pumps should not be used for rates which exceed approximately 12 to 20 lbs. per day of sodium fluoride. Ejectors and pumps will clog excessively with calcium or magnesium fluoride unless the dissolver water is softened or calcium and magnesium are stabilized by polyphosphate treatment.

(6a.) Liquid feeders for feeding 3 to 4 per cent sodium fluoride solutions by gravity.

Table 2
ANNUAL CHEMICAL COSTS OF 1-PPM FLUORIDATION*

Chemical	Average Production—mgd.						
	0.10	0.25	0.50	1.0	2.0	5.0	10.0
Sodium Silicofluoride	$ 28.50	$ 71.20	$142.36	$ 284.70	$ 569.40	$1,423.60	$ 2,846.00
Sodium Fluoride	76.28	190.71	381.42	762.85	1,525.70	3,814.20	7,628.00
Hydrofluosilicic Acid	100.00	250.00	500.00	1,000.10	2,000.20	5,000.50	10,000.00

* Based on June 1951 cost data.

Table 3
FLUORIDE COMPOUND SUPPLY SOURCES

Silicofluoride	Sodium Fluoride	Hydrofluosilicic Acid
Blockson Chemical Co. Joliet, Ill.	Blockson Chemical Co. Joliet, Ill.	Davison Chemical Co. Baltimore, Md.
Davison Chemical Co. Baltimore, Md.	General Chemical Div. 40 Rector St. New York 6, N.Y.	Harshaw Chemical Co. Cleveland, Ohio
E. I. du Pont De Nemours & Co. Wilmington 98, Del.	Aluminum Co. of America 624 Gulf Bldg. Pittsburgh 19, Pa.	E. I. du Pont De Nemours & Co. Organic Chemicals Dept. Philadelphia, Pa.
U.S. Phosphoric Products Co. Tampa, Fla.	American Agricultural Chemical Co. 50 Church St. New York City, N.Y.	Baugh Chemical Co. Baltimore, Md.
Baugh Chemical Co. Baltimore, Md.		
Henry Sundheimer Co. 103 Park Ave. New York 17, N.Y.		

(6b.) Proportioning pumps for feeding sodium fluoride solutions against pressure.

If hard water is encountered, a softener should be provided to make up the solution and prevent loss of fluoride which will precipitate out as magnesium or calcium fluoride.

In systems (6a) and (6b), it is more complicated to measure both the sodium fluoride and water to make up a solution of known strength than simply to fill the hopper of a dry feeder or the tank of a saturator. If waters of high calcium and magnesium content are encountered, the softener is an added item of equipment requiring attention and further complicating the installation. The addition of phosphates involves handling additional chemical.

Handling and Storing

The chemical must be moved into the plant and stored before being put into the feeder. The cost of this handling is just as important as the cost of the chemical itself. Chemical handling and storage may therefore logically be considered first. The requirements for small plants will be discussed first, with recommendations for larger plants following in size order.

Storage should be convenient to the feeder for any size plant. The chemical should be stored in a dry room, not directly on a concrete floor laid on the ground. Moisture can be absorbed through concrete flooring, and even steel drums should be placed on boards or grids to allow circulation of air to prevent "sweating" on the bottom.

Hydrofluosilicic Acid

If hydrofluosilicic acid is obtained in drums, they should be placed on a platform scale beside or below the proportioning pump for convenience in checking the amount fed. As requirements will be low, only one or two drums will ordinarily be kept in storage. Standard two-wheeled, rubber tired industrial hand trucks or special drum trucks provide an easy means of handling the drums.

Rubber gloves, goggles and rubber aprons should be worn when handling drums.

This chemical should not be diluted as such practice may cause the silicic acid to gel. The acid will also be more active. Pumps should be used in smaller plants for feeding the acid since they provide a closed system and can take their suction directly from the shipping container. The container should be placed on scales to check the rate of feed. This method avoids the need for sampling or for any other handling of the acid.

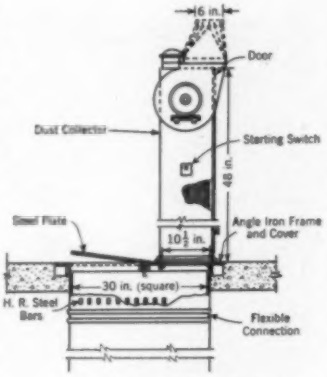

Fig. 3—Extension Hopper Design Variation

This extension hopper has been stopped flush with the floor to conserve aisle space. The dust collector can be turned through 180 deg.

Fluoride or Silicofluoride

If few in number, 100-lb. bags can be transported by hand trucks. Four or five 100-lb. bags, measuring 17 × 25 × 6½ in., can be stacked easily on a "stevedore" truck. Rubber tired trucks are easier to use and less damaging to floors.

If pressed for dry materials storage space, a storage hopper should be constructed above the feeder to hold the entire shipment of chemical. The floor-to-floor distance assumed in Fig. 1 is 13 ft. Since the hopper is a 6 ft. cube, it will hold 200 cu.ft., or approximately half a carload of fluoride compound and require only 36 sq.ft. of floor space.

Storage in bags requires floor space whereas chemical storage hoppers can utilize overhead space not generally used. A bin gate or valve should be used for filling the smaller feeder hopper from the storage hopper. The feeder hopper should be vented back to the top of the storage hopper. This arrangement results in a single handling of the chemical and solves the problem of segregated storage. For dumping such large quantities of chemicals, adequate dust removal equipment must be provided.

If the dry chemical is to be stored and used in considerable quantities, such as carload shipments, good material handling practice may indicate pallet storage and transportation by dollies.

The size of elevators or doorways often determines pallet size. A 30 × 48-inch. pallet having a platform height of 11 in. and holding 25 100-lb. bags, six bags high, with one in the center may be used. The total height from the floor will be 54 in. The advantage of pallet handling is that it decreases labor needs, dust and breakage.

In handling carloads or any large quantities of the fluoride compounds, respirators* should be worn.

Barrels and large drums (350 to 450 lb.) are seldom used but may be desirable because of shipping limitations. Their weight may render them difficult to handle. They may be transported on the level with a two-wheel industrial truck. An elevator or hoist is necessary if they are to be elevated or stored in tiers. Fig. 2 illustrates the use of a dust canopy for

* Bureau of Mines mask BM2101 and filter BM2133 are recommended. They are available from Mine Safety Appliances Co., 232 N. Braddock Ave., Pittsburgh, Pa., and Davis Emergency Equipment Co., Inc., 45 Halleck St., Newark, N.J.

filling a hopper from barrels or drums without escape of dust. A filter is necessary to prevent the escape of dust if more than one drum is to be emptied into the hopper.

Filling Feeder Hoppers

In smaller plants, it is desirable to have chemical feeder hoppers or dissolving tanks for liquid feeders, or proportioning pumps that hold at least an entire container of material. For bags, this amount is approximately 125 lb. Accommodation for a fresh bag or carton to be kept available before the hopper runs empty should be provided so that there will be:

1. Less handling of fluoride, with saving of time.
2. Less dusting, with improved working conditions.
3. Less chance of spilling, with savings of chemical.

If more than one bag is emptied at a time, or if large drums or barrels are emptied, dust removal equipment should be provided. Outside discharge from the dust filters must be provided. Dust removal is desirable for even the small installations. Proper design of the hopper or loading door will, however, permit placing the entire container within the hopper to allow the bag or drum to empty itself after the door is closed.

Filling should not be a disagreeable task and should be performed by one operator. Filling openings should therefore be at a convenient height, and the need for step ladders, boxes or platforms, to fill the hopper should be avoided. If the filling openings are high, there is a tendency to transfer the chemical from the original container to a smaller one to facilitate lifting, thus causing spillage, excessive dusting and waste of time.

If the extension hoppers extend through the chemical storage floor above the feeders, it is often desirable to extend them as high as possible to increase the storage capacity. A convenient loading height is 24 to 30 in. The maximum height of 36 in. should be used only if quantities used are not too great. A convenient height if barrels or large drums are to be emptied is 12 in., as the edge of the hopper can be used as a fulcrum point to aid in upsetting the barrel.

If the extension hopper extends through the floor and takes space needed for aisles, as shown in Fig. 3, the hopper can be stopped flush with the floor.

Feeder Requirements

There are four basic requirements of feeders for fluoride chemicals: accuracy, dosage check, efficient dissolver and protection against overfeeding.

Accuracy

The term accuracy may be applied to so many aspects of a feeding problem that it is advisable to define and clarify the limitation of the term. Accuracy generally means uniformity of feed once the rate is established. For volumetric feeders, whether dry feeders or proportioning pumps, the usual tolerance is plus or minus 3 per cent. For gravimetric weighing feeders it is plus or minus 1 per cent.

Tests on volumetric feeders may occasionally indicate a uniformity of feed within 1 per cent by weight. Such accuracy can result if the density of the material has remained extremely uniform. Variations in weight per unit of volume may and do occur, however, because of: [1] compression of chemical by its own weight, piled in the hopper, [2] compression by vibration from other machinery

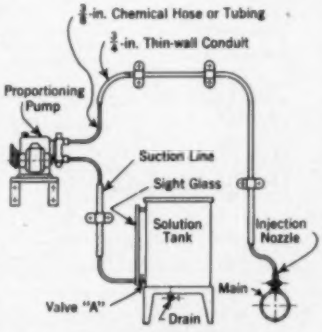

Fig. 4—Proportioning Pump Installation
When valve A is closed the pump draws directly from the sight glass, showing the exact amount delivered by each pump stroke without interrupting the feed.

or the feeder itself, [3] different flow characteristics caused by slight differences in moisture content or storage conditions and [4] variation in density or particle size between different shipments or even between different bags in the same shipment.

There are many other factors, but all manufacturers of chemical feeders generally know that under ideal conditions, with clean feeders the machine will deliver plus or minus 1 per cent of the desired amount by volume. Manufacturers should not, however, be expected to stretch their consciences by guaranteeing accuracies closer than plus or minus 3 per cent for volumetric feeders under field conditions.

Rate of Feed

Accuracy in setting the rate of feed is also important. Accuracy can be achieved most easily in volumetric feeders if the adjustment scale is linear and contains a large number of scale graduations. Closer settings may be made if the scale has 100 readable graduations than if there are only 10. The recommended type of linear scale is calibrated in percentages. If the scale is nonlinear, a calibration chart must be referred to when setting the rate of feed.

Volumetric feeders must be calibrated or tested on the particular chemical to be fed to determine the feed rate for a given setting. Gravimetric feeders should be capable of being preset exactly to the desired rate without calibration.

Accuracy of volumetric feeders is very closely related to a compressibility factor and to flow characteristics. The rate of feed of activated carbon, which is very compressible may therefore be expected to vary by plus or minus 10 per cent through volumetric feeders, hydrated lime and light soda ash by plus or minus 5 per cent and alum and dense soda ash by plus or minus 3 per cent. Gravimetric feeders are not affected by variations in density or flowing characteristics of the material being handled. Those suitable for feeding small quantities of fluoride compounds have feed control rates operated by synchronous motors and should deliver within plus or minus 1 per cent of the desired amount.

Dosage Checking

Good engineering requires that means be provided to check the feeder accurately for the amount of chemical being delivered. Periodic sampling is not desirable for several reasons:

1. Fluoride chemicals (acid, dry or solution) should not be handled.
2. Test periods must be comparatively long or they are inaccurate.
3. Interruption of chemical dosage is undesirable.
4. The practice is time-consuming.
5. Over- or underfeed may occur between sampling periods without being detected.

Provisions for continuous testing are so inexpensive and simple to provide that they should not be omitted. This operation provides a means of keeping necessary records and more closely controlling plant operations.

If hydrofluosilicic acid is pumped by a proportioning pump to the application point, the original acid container can be placed on a platform scale and loss in weight read at convenient intervals. Beam scales are relatively inexpensive, and at a nominal expense they can be equipped with vernier indicators that make them dial scales with 100-oz. ranges. After 100 oz. has been fed the tare

weight is shifted. These indicators are especially recommended for very low feed rates (1½ lb. per hour or less). Dial scales, furthermore, cost about four times as much as beam scales.

Loss-in-weight type gravimetric feeders have built-in scales that control the feed rate. Chart recorders can easily be attached to gravimetric feeders.

If sodium fluoride solutions are to be pumped or measured by any other type feeder, several simple methods of continuous testing may be used. The simplest is a scale attached to the inside of the tank that can be easily read by the operator, although, for a deep tank, a float, cable, pulley and scale on the outside of the tank would be better. A sight glass will show the level in the tank at all times and, if connected to the tank and pump as shown in Fig. 4, will serve as a test gage to show how much the pump is delivering with each stroke. If the solution rises in the sight glass during a pressure stroke the suction valve is faulty. The indicator will also show whether the foot or discharge valve is at fault. If the proper volume is not drawn in by the pump, the discharge valve is at fault.

By providing an accurate water meter on the makeup water supply to a sodium fluoride saturator, a record of the sodium fluoride used may be kept.

Dry feeders for low rates of feed should be placed on a platform scale as described above for acid tanks, and vernier indicators used to check the feed at low rates.

Dissolving Tanks

Dissolvers should not be on the scales of small feeders for two reasons:

1. When feeding a few ounces per hour, the slightly fluctuating water level in the dissolver makes loss-in-weight tests unreliable, except for long runs.

2. Condensation on the dissolver increases in humid weather and runs down upon the scale thus increasing the weight on it.

Large dissolvers used for higher feed rates would also not be placed on scales because of their great weight.

Because fluoride compounds dissolve slowly and only partially, dissolvers must provide ample retention time. Sodium fluoride is soluble to the extent of only slightly more than 4 per cent. Solubility tables are based on pure (distilled) water and unlimited solution time. Practical considerations of limited time and less than ideal conditions suggest that about one-fourth of the ultimate solubility, or 1 per cent, can be obtained in a continuous dissolver. A solution of 1 per cent strength obtained with approximately 12 gal. of water per pound of chemical. Assuming a rate of feed of 10 lb. per hour, the water requirements will be 120 gph. or 2 gpm. A five-minute retention period will therefore require a 10-gal. dissolver.

Dissolver Size Formula

From these considerations, it is apparent that, based upon 1 per cent solubility in five minutes, a formula for dissolver sizes for sodium fluoride may be written: dissolver size (volumetric capacity) equals 1 gallon of capacity for each pound per hour of sodium fluoride fed.

Dissolvers should be sized for the maximum rate for which they will be used. When operated at less than the maximum rate, the amount of water used is the same (or approximately the same) as at the maximum rate, since the power is required to stir the same volume of water. The solution leaving the dissolver is weaker at lower rates but this is not harmful as no water is wasted. Only the power is extracted from the water to stir the dissolver.

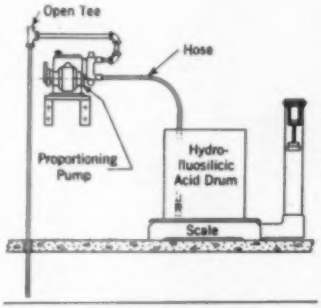

Fig. 5—Proportional Pump Installation Variation

This arrangement is used when pumping to a lower level such as the flume below the floor, which is the treatment point in this installation. The open tee provides a break in the solution line to prevent siphonage.

Because very small jets tend to clog, and there is no economy in fabricating an extremely small dissolver, the smallest ones are made to hold about 5 gal. These units will dissolve a maximum of approximately 5 lb. per hour of sodium fluoride or 2.2 lb. of fluoride ion per hr.

The same method may be used for computing the dissolver capacity for sodium silicofluoride. Based upon a solubility of 0.2 per cent (approximately 25 per cent of maximum) to 1 per cent for sodium fluoride, it is evident that five times as much water will be required or 5 gal. per pound per hour of silicofluoride fed. A 5-gal. capacity dissolver is therefore suitable for dissolving approximately 1 lb. of sodium silicofluoride (0.6 lb. of fluoride ion) per hr.

If large quantities of dry fluoride compounds are fed (more than 20 lb. per hour), dissolvers which have two or more compartments through which the fluoride must pass in series, or adequate baffling, are advisable to prevent undissolved fluoride from short circuiting through the outlet of the dissolver.

Necessity for Dissolvers

These factors raise the question of the necessity for efficient dissolvers against feeding, for example, a slurry of sodium silicofluoride. If undissolved fluorides are fed before filtering, they will be retained by the filters until dissolved. This situation will result in the loss of some fluoride. The amount will depend on the character of the water, type and amounts of coagulants carried to the filter and point of application. Losses of more than 25 per cent may result if fed with coagulants.

If the undissolved fluoride is fed into the filter effluent on the way to the clear well the fluoride will probably dissolve enroute—or, at any rate, eventually. If the fluorides are added to the clear well proper, one may ask whether undissolved particles settle out in dead spots to build up undesirable concentrations. This result will probably not occur.

If slurry is added to a main leading from a deep well pump to a distribution system, the fluoride will undoubtedly be dissolved before the water reaches the first customer, if the main delivered to a storage tank or reservoir directly before any customers tapped it. Although no two systems are identical, certain general rules should be given. One approach is to allow the same time for slurry to dissolve in the main that is allowed in the dissolver of a dry feeder. Taking 5 minutes as dissolving time and assuming a flow of 10 fps. in the main, it is found that 3,000 ft. ($10 \times 60 \times 5$) of main will be required to provide the required detention to insure solution.

It seems prudent to recommend that dissolvers be made as efficient as possible. Some small amount of chemical is almost certain to short circuit to the outlet without dissolving. The number or size of the particles may be so small that they will dissolve

completely in the solution line conveying them to the application point. The amount of chemical short circuiting through a dissolver can be expressed as a proportion of the amount fed and will bear a straight line relationship to the rate of feed. As dissolving rate approaches design capacity, a larger proportion therefore short circuits.

Laboratory tests and field experience have indicated that a 5-minute dissolving time is adequate at the above concentrations, which are approximately one-fourth of ultimate solubility. If, in addition, baffling provides a path of longer duration and a quiet zone at the outlet, a negligible amount of undissolved fluoride will leave the dissolver, so that all fluoride fed is accounted for in final analysis of the water in the distribution system.

Prevention of Overfeeding

Positive prevention against overfeeding is essential in all installations. In proportioning pump installations there is little or no possibility of this condition when injecting against pressure or elevating to a higher point of treatment. When pumping to a lower level or into a suction line, an air gap or positive break in the solution line should, however, be provided. Fig. 5 illustrates a proportioning pump for pumping to a lower level and Fig. 6 shows how a suction box may be used to introduce solutions into a suction line to prevent siphoning. Suction boxes may be used with dry feeders and dissolvers.

In small dry feeders, in which the hopper holds not more than one or two bags of chemical, there is very little or no danger of "flooding" through the feeding mechanism and unloading the hopper, to cause an overfeed. It is only in the larger plants or where tall extension hoppers are used that this danger exists.

Causes of Flooding

Flooding or unloading of chemicals from hopper occurs in only two ways:

(1.) It can occur when powdered material is dumped into the hopper of an empty feeder, so that it falls a considerable distance and entrains air, causing it to flow on out through the open feeding mechanism from its own velocity. The remedy is to refill before the hopper becomes empty, and while the feeder opening is well plugged by deaerated chemical.

(2.) Flooding can occur during feeding if chemical arches in the hopper, thus emptying the feeding mechanism, and then the arch breaks, allowing the material to cave in. In collapsing, the chemical entrains air and becomes fluidized so that it can flow through an open feeding orifice like a liquid. Although proper agitation will prevent an arch from forming, accidents happen, and the surest preventive is the use of a feeding mechanism that provides a positive stop or lock against the chemical, as shown in Fig. 7.

If large hoppers are used above small feeders, to provide storage, bin gates or valves should be used between hoppers and feeders so the feeders can be refilled at proper intervals.

Cross Connections

In piping the dilution water to the dissolver of a dry feeder, a saturator or a dilution tank for making solutions of sodium fluoride, cross connections should be avoided. This point has been raised by state board of health engineers who stated that if this precaution is not taken, a lowered pressure in the water system may permit the concentrated fluoride solution to siphon back into the water pipes or the system. When pressure is again resumed the concentrated solution might be diverted to drinking fountains, plumbing fixtures or other uses and endanger health.

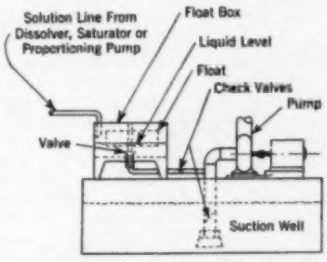

Fig. 6—Suction Box Installation
Use of a suction box is another method of preventing siphonage.

In sodium fluoride solution tanks or dry feed dissolvers with mechanical agitators, cross connections are easily prevented. The water supply to the tank is terminated at a point above the highest possible liquid level, so that an air gap exists.

Siphon breaks can be installed in saturators. In dry feeders which utilize water pressure for agitation, a very simple nonmechanical siphon breaker or vacuum breaker can be provided in the piping.

Dissolver or Solution Tank Materials

Solutions of sodium fluoride are corrosive but not extremely active, and stainless steel tanks of proper composition have proved satisfactory. The following materials are also entirely satisfactory: ceramics, rubber-lined, plastic-lined or asphalt- and cypress-lined steel dissolvers, or asphalt-lined (or painted) concrete. Frye at Evanston, Ill.,* states that the pH of the solution leaving their dissolver is 7.7 if the pH of the finished water is 7.6.

Solutions of sodium silicofluoride have a much lower pH and are much more corrosive. McCarthy† at Racine, Wis., reports that the pH of the solution leaving the dissolver in their installation is 4.0. The solution leaving the dissolver in a typical installation has a pH of 4. The very weak solutions found in the dissolvers under dry feeders do not, however, seem to be as active as originally thought, and type 316 or 317 stainless steel seems to hold up well. The materials of construction listed above for sodium fluoride are also suitable for silico-fluoride solutions.

Hydrofluosilicic acid should be handled with rubber or plastic materials. Although the acid is saturated with silica and is not extremely active in the concentrated form in which it is shipped, it either absorbs atmospheric moisture at the liquid level or is slightly fuming, so that even glass will be etched above the acid level. The acid should not be diluted and should be used directly from the container in which it is shipped.

Automatic Proportioning

The majority of the automatic proportioning installations will be of the constant rate type, although many of the smaller plants, especially those having well supplies, will require automatic start-stop mechanisms to permit the equipment to function only while the well pumps are in operation. This automatic functioning is easily managed with either dry or solution feeders. A relay in the starting circuit to the deep well pump motor can also start and stop the chemical feeder motor. For dry feeders, a solenoid valve, to open when energized, is required in the water line to the dissolver.

If an eductor is used to pick up the solution from the dissolver and force it to a higher elevation or into a main against pressure, a solenoid or motor operated valve is required for this line also.

In plants where the flow varies hourly or is changed several times a day, as if with well pumps that start

* Communication from Horace R. Frye, Supt. Evanston, Ill., Water Dept.

† Communication from J. J. McCarthy, Dir. of Labs., Racine, Wis.

in sequence to satisfy varying demand rates, automatic proportioning is essential. This operation requires that the water be metered so that automatic proportioning equipment can control the feeders to change their rate automatically in proportion to flow. Summation instruments are available for totaling the flow if more than one metering point is necessary. Accuracy of proportioning can easily be determined and recorded if accurate means of checking the amount of chemical fed are provided. It is necessary only to check the volume pumped with the weight of fluoride used to determine whether proportioning has been accurate. Either venturi or propeller type meters may be used to pace the chemical feeders.

In cities supplied by a series of wells that start and stop automatically and do not deliver to a common point, it is necessary to have an individual installation for each well.

Piping

The most satisfactory method of conveying fluoride solutions to the application point is through a rubber hose, although the necessity to support the hose for its entire length to present a neat appearance and prevent air pockets is a disadvantage. Many types of plastic and plastic-lined pipes have been placed on the market recently, all of which are suitable for sodium fluoride, silicofluoride or hydrofluosilicic acid. Since fluoride installations have been in operation for only about five or six years, it is not possible to base recommendations on a longer history of experience. Many plants have also been using ordinary steel pipe for sodium fluoride solutions with satisfactory results, although silicofluoride solutions have been found to destroy steel pipe very rapidly.

Adequate pitch must be provided if gravity flow is employed, and the line should be vented at the dissolver. If the discharge end of the solution piping is below water level, it should be vented again at the last point at which it makes a vertical drop (Fig. 8).

Eductors

If gravity feeders, such as dry feeders, are used, the solution may be forced to a higher elevation or injected into a line against pressure by eductors. Water to operate the eductors should be at a pressure of at least four times the discharge head, and the eductor should always be kept fully supplied with solution on its suction side. A makeup tank is therefore usually required, or the eductor suction may be taken from the bottom of the dissolver utilizing a float valve to insure constant level. This practice renders water jet agitation inapplicable, making mechanical agitation necessary.

Scaling

If eductors are used for handling fluoride compounds in hard water, some scale formation must be expected. The rate of formation depends somewhat upon the water hardness but primarily upon the volume of fluoride handled.

In a city using Lake Michigan water having about 37 ppm. calcium and 8 ppm. of magnesium hardness, and feeding approximately 10 lb. of fluoride per hour, scale formed upon 1¼ in. eductors within one or two weeks. As this condition was entirely unsatisfactory, changes were made in the solution line to permit gravity flow, and no further formation was

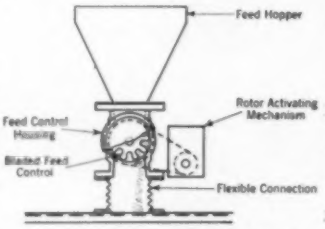

Fig. 7—Non-flooding Type of Feeder

Air laden chemical can not gush through the bladed feed control mechanism.

encountered. It appears that magnesium and calcium fluorides precipitate as a hard scale in zones of intense agitation, whereas they settle out as soft sludges in the absence of speed and agitation. Neither sodium fluoride nor silicofluoride has caused scale formation in gravity flow lines.

In another water supply containing about 40 ppm. calcium and 6 ppm. magnesium, approximately 3 lb. of sodium fluoride per hour was being fed. Scale formed on the eductor in approximately 90 days. Although this condition is not desirable, it was felt that it was preferable to change the eductor, which was arranged between unions for easy removal once every three months, rather than to effect line changes.

Pumps

If any high speed pump, such as centrifugal or turbine type pumps, is used to move the fluoride solutions and hard water is used for makeup to maintain capacity operation, clogging and scaling may be expected. Fig. 9 illustrates conventional installation of a dry feeder with makeup tank and ejector.

If sodium fluoride solutions are introduced by proportioning pumps through injection nozzles into mains carrying water containing calcium or magnesium, precipitation will occur at the injection point. To prevent this precipitate from building up and eventually clogging the injection pipe, the end should extend through a corporation cock to facilitate removal and cleaning.

Prevention of Scaling

Scale formation may be prevented by softening all the water used to convey the sodium fluoride solution or by treating it with a sequestering agent such as Calgon,* Micromet* or Nalco 918†. For eductors, both the dissolving and the eductor water should be softened or treated. In pumping, only the dissolver water need be softened or treated as the excess capacity of the pump over the amount of dissolver water used can be recirculated through the dissolver by a float valve.

The polyphosphate required is a function of water volume as well as chemical characteristics, although the relationship is unknown and can be determined only by trial and error. Experience indicates that treatment may range from 7 ppm. to 15 ppm.

Since requirements for Calgon or Micromet are the same, the cost of this method depends on price of the chemical and the application equipment. Calgon and Nalco 918 costs approximately 20c per lb. and require a motor driven feeder. Micromet costs $1.25 per lb. but can be fed by a pressure pot type of feeder which is nonmechanical and very inexpensive, costing approximately $50.

In making up solutions of sodium fluoride for proportioning pumps, polyphosphate may be added to the dissolving water to prevent precipitation of calcium and magnesium fluoride sludge. This practice will also prevent calcium buildup at the injection nozzle discharge orifice where the solution is introduced into a main under pressure. One to two oz. (5 to 10 times the hardness in ppm. as $CaCO_3$) of polyphosphate per 100 grains of hardness in the dissolving tank may be required to sequester the calcium and magnesium completely.

A possible objection to this use of polyphospates is that it may cause a slight increase of the apparent fluoride content, as indicated by certain

* Products of the Calgon Corp., Pittsburgh, Pa.

† A product of National Aluminate Corp., Chicago, Ill.

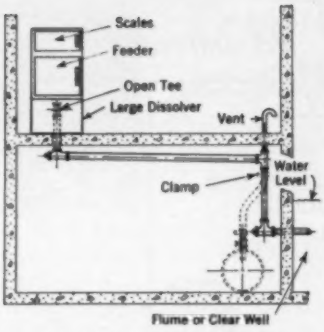

Fig. 8—Gravity Feed Installation

Arrangement provides gravity feed to a flume or clear well. The vent must be provided if the vertical drop extends below the water level. Tees or crosses should be used instead of ells in the solution line to facilitate inspection or cleaning of the line. The dotted line insert indicates method of connecting to filter effluent line.

laboratory methods. The amount of polyphosphate so added should be quite small in comparison with the normal polyphosphate treatment of municipal water supplies.

Silicofluoride not Scale Forming

Sodium silicofluoride solutions may be handled in eductors without clogging by calcium or magnesium fluoride deposits as calcium and magnesium do not readily precipitate at low pH values. Silicofluoride solution has been handled by an eductor for sixteen months with no difficulty at Oshkosh, Wis.‡

A very small installation in Wisconsin has used a ⅜-in. bronze eductor for silicofluorides for approximately one year without any trouble.

Dosage Points

The conventional application point for fluoride solutions is in filter effluent lines or in the clear well. At small plants using well supplies, the solution is injected into the discharge from the deep well pump.

The water utility at Racine, Wis., using Lake Michigan water, adds silicofluoride to the filter influent and the fluoride loss is approximately equal to the 0.1 ppm. fluoride content of the raw water.

Fluoride should not be added with or before coagulants or with softening chemicals. Feeding sodium fluoride solution ahead of lime softening has on occasion caused the loss of approximately one-fourth of the fluoride. Aluminum sulfate has even been used to effect fluoride removal.

‡ Private communication from H. J. Schneider, Filtration Supt. and Chemist, Oshkosh, Wis.

Records

Most state health departments insist on periodical reports on the amounts of fluoride and chlorine used, and some request reports on consumption of all chemicals. Keeping accurate records also results in better equipment and plant maintenance and more careful operation of equipment in addition to the accumulation of data that can be used in making authentic surveys and studies of water treatment practice and results. This practice is mentioned because the chemical feeder installations should be planned so that the keeping of records is facilitated.

Conclusions

One of the greatest problems confronting communities wishing to fluoridate their water supplies is the availability of suitable fluoride compounds. There is an adequate source of fluoride as a by-product of fertilizer manufacture, although a very considerable expenditure will be necessary to supply fluorides by this process, as rubber-lined equipment is required to produce either fluosilicic acid or silicofluoride. A single large superphosphate fertilizer plant may have a potential to produce between 3,000 and 4,000 tons of 22 per cent hydrofluosilicic acid per year. With the possibilities that interest in the fluoridation program will decrease sharply, and that some method of introducing fluorine into the diet other than through water, the reluctance to make the required investment is understandable. Manufacture of the acid requires somewhat less equipment and skill than manufacture of the sodium silicofluoride. The manufacturer's problem is disposing of acid that has been produced—he must ship it, sell it, get rid of it. The encouragement of 5-year contracts for acid at prices competitive with current prices for silicofluoride (5 to 6c per lb.) on a fluorine content basis would probably bring some recovery plants into existence.

The construction of sodium silicofluoride plants has some appeal because this material can be stored easily and inexpensively. Salt (sodium chloride) is plentiful, and a shortage such as was experienced last year in soda ash, which is used in sodium fluoride production, will probably not be experienced. It is certain that the law of supply and demand will also eventually solve this problem.

Only the three most available fluoride compounds and their handling have been discussed in this review. Almost all the clinical evidence supporting the benefits of fluoridation has been based on the use of sodium fluoride, although it is believed that other compounds will prove equally beneficial. Selection of an installation that is flexible enough to permit a choice of fluoride compounds may therefore have future advantages and thus affect one's viewpoint.

Basic Information on Fluorine Chemicals

Sodium Silicofluoride (Fluosilicate) Na_2SiF_6

Characteristics. The density of this compound is approximately 72 lb. per cu. ft. It is white (unless tinted nile blue for identification), and is a free-flowing, nonhygroscopic, crystalline powder which contains no water of crystallization. Containers carry a warning label to avoid hazardous handling. The pH of a solution depends upon several factors such as 1 per cent solution of 98 per cent Na_2SiF_6 has a pH of 6.5, and a 4 per cent solution of 95 per cent Na_2SiF_6 has a pH of 7.6.

Packing. Lots of 100 lb., net, are packed in moisture-proof paper bags that are approximately 17 × 25 × 6½ in., while 125-lb. lots are provided in fiber drums, and 425-lb. lots (499 lb., gross) are available in paper-lined slack barrels or fiber drums.

Shipping regulations. Paper bags may be used only for carload lots or truck shipments. There is an extra charge for barrel or drum shipments of approximately $.20 to $.40 per cwt. Bulk shipment is not currently permitted by ICC regulations.

A minimum carload quantity depends on shipping point and destination but is usually 30,000 lb. Maximum carloads may be more than 80,000 lb. Truckloads are ordinarily approximately 20,000 lb.

Sodium Fluoride (NaF)

Characteristics. This material has a density of 65 lb. per cu. ft. It is white (unless tinted nile blue for identification), odorless, nonhygroscopic and crystalline, and is available in either powdered or crystal form. Containers carry a warning label.

Packing. It is packed in the same types of containers for corresponding lot sizes as silicofluoride, although the large drums usually hold 375 lb., net.

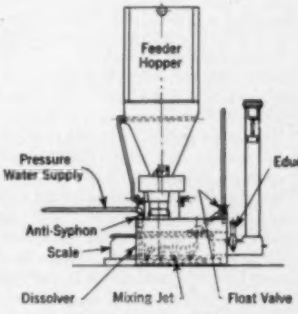

Fig. 9—Dry Feeder Installation With Makeup Tank and Ejector

The water supply from the float valve terminates above water level. Pressure water supply to the eductor should be approximately four times the discharge pressure. Pressure water is also used for jet agitation.

Shipping regulations. Provisions for shipment are the same as those for silicofluoride.

Hydrofluosilicic Acid (H_2SiF_6)

Characteristics. Commercial grades vary in strength from 22 to 30 per cent. The weight is 10.5 lb. per gal. It is a transparent, colorless, highly corrosive, slightly fuming liquid and, although not as dangerous to handle as sulfuric, hydrochloric or nitric acids, as it does not act as rapidly on the skin, caution should be exercised when handling it.

Packing. This compound is available in the following shipping containers: 10-gal. carboys, 100-lb. wooden kegs, 125-lb. and 420 to 550-lb. rubber-lined steel drums and 90,000-lb., net, rubber-lined tank cars. Deposits, such as $30 for a 125-lb. rubber-lined drum, are required on returnable containers.*

Shipping regulations. As this material is a corrosive liquid, a white label is required. Samples cannot be sent through the mails.

Decomposition. Hydrofluosilicic acid is generally believed to exist only in solution, and not in the vapor phase. Upon vaporizing, it decomposes into hydrofluoric acid (2HF) and silicon tetrafluoride (SiF_4). This equilibrium exists at the surface of strong solutions. The small concentration of hydrofluoric acid may slowly attack the glass above the solution level. It is therefore ordinarily shipped in rubbed-lined containers.

* Information from Davison Chemical Corp., Baltimore, Md.

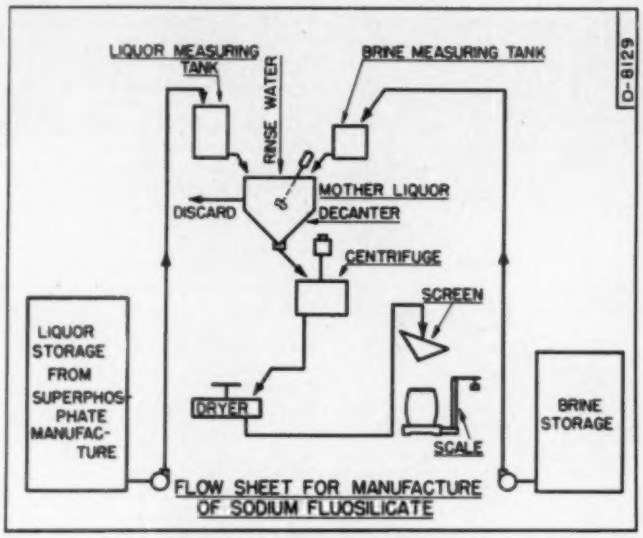

Fig. 10—Flow Sheet for Sodium Silicofluoride Manufacture

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3. Munroe, Henry. Fluoridation. Proportioneers, Inc., Providence, R.I. (1950).

"Gerry" Arnold New Head of Water Resources Division in N.P.A.

Gerald E. Arnold of San Diego, Calif., has been appointed director of the Water Resources Division of the National Production Authority.

He comes to NPA on leave of absence from San Diego, which he has served for six years, first as Assistant City Manager and more recently as Director of Water.

Mr. Arnold succeeds Harvey S. Howe, who is returning to the Lock Joint Pine Co., which lent his services to NPA to organize the Water Resources Division and head it until a permanent director could be obtained.

Mr. Arnold's broad experience in the water resources industry includes work in construction of facilities, manufacture of components, operation of municipal plants, and supervision of governmental utility activities.

As sanitary engineer with rank of Major in the U.S. Public Health Service during the war years, Arnold was assigned to the Office of Civilian Defense in charge of security matters in the utilities industry in 11 western states.

Thereafter he was assigned to the War Production Board, in charge of utility operations in the western area, with headquarters in San Francisco.

A graduate of Colorado State College, Mr. Arnold organized San Francisco's Water Purification Division and served as its head 1931 to 1942.

Before this Mr. Arnold for a year had been chief engineer of the Western Well Works in San Jose, Calif., which manufactured pumps and pumping equipment, drilled wells and installed complete water systems.

He is president of the San Diego section of the American Society of Civil Engineers and chairman of the California section of the American Water Works Association which honored him in 1938 with the Fuller Award "for distinguished service in the water supply field".

"Gerry" Arnold's broad experience in the water supply field, together with his wartime service in the Utilities Branch of the War Production Board will stand him in good stead in his new undertaking as head of the Water Resources Division of N.P.A.

Indianapolis Has First Two Billion Gallon Month

Water pumped by the Indianapolis Water Co. passed the 2,000,000,000 gallon mark in a single month for the first time, during August, 1951—a new record!

On August 31, with a high for the day of 99 degrees, a new record for a single day's pumpage was established at 74,850,000. The average day's pumpage for the month of August was 65,820,000.

N.P.A. Names Meter Industry Advisory Comm.

The National Production Authority has named the following representatives of the water meter industry to serve as an Advisory Committe, representing the Water Meter Industry in matters pertaining to the production and distribution of water meters. The committee is:

C. W. Wright, President, Badger Meter Co.
H. F. Barrett, Sales Mgr., Buffalo Meter Co.
F. P. Hersey, Vice Pres., Hersey Mfg. Co.
Chas. Bachmann, Asst. G.M., Neptune Meter Co.
A. R. Whittaker, Genl. Mgr., Natl. Meter Div.
P. R. Carlon, Genl. Mgr., Well Machy. & Supply Co.
W. C. Flanders, Asst. G.M., Worthington Gamon Co

Free Chlorine, Monachloramine and Dichloramine in Water*

Determination by Palin Method and Amperometric Procedure

Second and Concluding Installment

by D. B. WILLIAMS, *In Charge of Purification*
Brantford Water Works, Brantford, Ont.

(The previous installment of this article dealt with the techniques of the two methods discussed and supporting data for the amperometric test. This installment discusses the use of the amperometric test in plant operations and the determination of chlorine residuals in distribution systems. Ed.)

Palin and Amperometric Procedures in Review

The *Palin titration* method appears to be a very useful qualitative procedure for differentiating between the various forms of available chlorine. In the determination of hypochlorous acid, the method is accurate and reliable quantitatively. As applied to the determination of the monochloramine fraction, the precision and reliability of the method are satisfactory at lower water temperatures but at higher temperatures (normally found in some supplies in North America in summer), the method becomes unsatisfactory.

In determining dichloramine, the method is somewhat erratic from the quantitative view at low temperatures and is not useable at temperatures in the 25°C range.

The *amperometric titration* method has been modified along the lines indicated by Palin's work and by proper control of iodide ion concentration and pH, hypochlorous acid, monochloramine, and dichloramine can be precisely and quantitatively determined.

The writer suggests that the reader now take the broad view that these two apparently different and opposed procedures are really one and the same thing with the exception that Palin relies on a color change brought about by the presence of neutral orthotolidine under a specific set of conditions whereas the amperometric relies on the movement of a needle in an amperometric titrator under essentially the same set of conditions. Therefore, it is neutral orthotolidine versus needle swing.

Having used both procedures for months, this author can state that the solutions listed by Palin (with the exception of the orthotolidine) may be used in the amperometric titrator to give identical results as found when using the solutions suggested by Marks and associates for the simple reason that they produce the same set of conditions. (No manganese in Brantford's raw water precludes concern over the fact that Palin's sulfuric solution gives a slightly lower pH than set out as a lower limit by Marks—this might be of concern in other waters and reducing the strength of Palin's acid or using Marks' pH 4 buffer would be necessary.)

The writer prefers to use the amperometric procedure because orthotolidine is a mediator rather than an indicator and therefore causes inaccuracies, particularly in warm waters and further, the movement of a needle is much more easily discerned than the final disappearance of a faint blue.

Plant Operations

In discussing actual plant operation all remarks are confined to determinations made by means of the amperometric procedure outlined above and for convenience will be called "the differential titration."

Effluent Chloramine

The plant in question is at Brantford, Ontario. Due to conditions imposed by the raw water, the process of a high degree of free residual chlorination is followed by dechlorination with SO_2 to a residual of zero (for all practical purposes). This is a subsequently followed by the application of ammonia, followed in turn by the application of chlorine to form a chloramine. This procedure described in detail elsewhere[8] is designed to give all the benefits of free residual chlorination without the annoyance, to the public, of NCl_3.

Using the differential titration, the effect of varying the ratio of post ammonia to post chlorine was studied. Results were as follows:

1 NH_3 : 4 Cl_2		
Hypochlorous acid	= 0	ppm.
Monochloramine	= 0.61	"
Dichloramine	= 0.24	"
1 NH_3 : 3 Cl_2		
Hypochlorous acid	= 0	"
Monochloramine	= 0.56	"
Dichloramine	= 0.11	"
1 NH_3 : 2 Cl_2		
Hypochlorous acid	= 0	"
Monochloramine	= 0.79	"
Dichloramine	= 0.13	"

It is seen that the dichloramine fraction of the total chloramine varies from 14 per cent with a ratio of 1 NH_3 : 2 Cl_2 to 28 per cent with a ratio of 1 NH_3 : 4 Cl_2. Even though theory had previously indicated that such would be the case, it still required the differential titration to prove that such was so. Proper regard was given to the necessity that all other conditions, including pH, remained unchanged and only the ratio of NH_3 to Cl_2 was altered for the purposes of this experiment. Doubtless the varying of ratio of NH_3 to Cl_2 in laboratory experiments has been done many times to vary the percentage of monochloramine and dichloramine in the final chloramine but here we have a case where the percentage of the two chloramines has been actually changed in plant operation, operating at a rate of 5 Imp. mgd. and by means of the differential titration the change has been accurately measured.

What does this mean to the waterworks chemist who is receiving complaints of chlorinous tastes?

Palin points out that Chapin[9] has stated that "in the physical properties of odor, ... dichloramine is intermediate between nitrogen trichloride and monochloramine."

Briefly, this means that nitrogen trichloride is the most noticeable to the public, dichloramine the next most noticeable, and monochloramine is the least noticeable. The author thoroughly agrees with Chapin in this regard but would add that nitrogen trichloride is very objectionable as an odor but not very noticeable as a taste; dichloramine being less objectionable than NCl_3 is still objectionable as an odor but more so as a taste, whereas up to 1 ppm. monochloramine is not objectionable as either taste or odor.

*An article prepared especially for *Water & Sewage Works*, based on cooperative research conducted in the author's laboratory and the laboratories of Wallace & Tiernan, Inc., Newark, N.J. The previous installment appeared last month.

Therefore, having removed NCl_3 by aeration, activated carbon, or conversion[7], we can then concern ourselves with keeping the percentage of dichloramine in the final chloramine as small as possible. All other conditions being equal we have seen that varying the ratio of NH_3 to Cl_2 will do this. Also, we have a suitable analytical technique to assess such operation. In addition one would expect that being able to control pH prior to ammonia and chlorine addition would have a significant effect.

It should be realized that currently at Brantford we are not able to control the percentage of monochloramine and dichloramine in the finished water as a continuous day-to-day operation but only so for short observational periods. The reason for this is that our present ammoniator and post chlorinator are not automatic and yet must deliver a chloramine to a highly variable outgoing load.

To be able to control the percentage of monochloramine and dichloramine as a regular operation would require, in view of the two outgoing venturi meters, two automatic ammoniators and two automatic post chlorinators. For other reasons, the installation of these has already been planned and the differential titration has further shown the wisdom of the proposed installation. It is also expected that the completion of a 500,000 gallon (Imp.) storage tank in the distribution system will smooth out the variable pumpage considerably, greatly simplifying chemical application.

Although our pre-chlorinators for free residual chlorination and our sulphonators for dechlorination are automatic from the standpoint of meeting variable pumpage it is still necessary to do considerable routine testing for the purpose of adjusting such operation. Therefore, it had already been planned to install three chlorine residual recorders; one to record free residual chlorination, the second to record dechlorination, and third to record post chloramination.

The purpose of three continuous records of three steps in our chlorination procedure is to blend the three operations into a more harmonious whole thereby facilitating more exacting but less time-consuming control. Since the original planning for such equipment was made, we find the use of the differential titration in the amperometric titrator attesting to the original wisdom of planning to install such chlorine residual recording equipment.

Dechlorination Control

In the meantime with present equipment the differential titration has been useful in another way. Normally the chloramine residual leaving our plant has a dichloramine content of approximately 28 per cent. In the range of a total residual of 0.4 to 0.6 ppm. this results in a residual that is not objectionable. Many times the author has noticed that suddenly the chloramine residual would become definitely noticeable having a distinct acrid taste. In all such cases the differential titration has shown that the dichloramine content had risen to the extent of being 50 to 60 per cent of the total residual and further in all cases this has been shown to be caused by incomplete dechlorination. With insufficient SO_2, some free chlorine would pass the dechlorination point and would essentially change the ratio of Cl_2 to NH_3 in the final step in the direction of higher dichloramine content.

The author has considerable evidence to be able to say that it is not the magnitude of the residual that causes the above-mentioned taste but rather the higher percentage of dichloramine. Conversely, if the differential titration shows a residual of normal magnitude (0.4 to 0.6 ppm.,) mainly monochloramine with only a trace of dichloramine, if any, then this is an indication of over-sulphonation with the post ammonia and post chlorine being set high to counteract over-sulphonation. In all cases where by differential titration this condition has been suspected it has always been found so on checking plant operation. In the case of over-suphonation, the excess SO_2 leaves untouched the NH_3 but, by destroying part of the post chlorine dosage, actually changes the NH_3 to Cl_2 ratio in the direction of a higher percentage of monochloramine, often to the exclusion of dichloramine.

Increase in Free NH_3

When checking free residual chlorination after a one hour contact period, we always find by this differential titration, free chlorine (2.0 to 2.5 ppm.) plus a monochloramine content of approximately 0.20 ppm. which varies very little from day to day. Of particular interest, however, is the dichloramine content which averages 0.30 to 0.40 ppm. If this small amount of dichloramine suddenly becomes, for example, 0.73 ppm. then it has been found to be the result of increasing free NH_3 content in the raw water, i.e., an increased chlorine demand. The first indication that we have of a possibility of slipping off "break point" is this increase in dichloramine content under free residual chlorination conditions.

Residuals in Distribution System

Regarding chloramine residuals in distribution systems, Palin makes the following statement:

"Where ammonia is always in excess of chlorine as in the chloramine treatment of water, the product, in neutral solution, consists almost entirely of monochloramine. The possibility of changes taking place later in water distribution systems should not be overlooked. Metals, for instance, might have catalytic influence."

Here again, the differential titration was of use in determining changes in relative proportions of monochloramine and dichloramine in the distribution system.

One sample a day was taken from a sample tap at the plant and at the proper time a corresponding sample taken at a point near the end of the system. A summary of these results is given in Table 4. Fraction 2 is monochloramine and fraction 3 is dichloramine. Throughout, fraction 1 free Cl_2 was zero. It is seen that in all cases the monochloramine concentration decreases at a more rapid rate than dichloramine. This results in an increase in the percentage of dichloramine since the total residual chlorine always decreases.

The apparent increase in concentration of dichloramine in a few cases may be within the limits of error due to imperfect synchronization of the

Table 4

MONOCHLORAMINE AND DICHLORAMINE IN A DISTRIBUTION SYSTEM
Values of Residual Chlorine in ppm. as Monochloramine (fraction 2) and Dichloramine (fraction 3)

Date	Plant Sample		System Sample	
	Fraction 2	Fraction 3	Fraction 2	Fraction 3
4-20-50	.36	.21	.26	.22
4-21-50	.34	.18	.12	.14
4-24-50	.35	.19	.20	.15
4-25-50	.46	.15	.19	.22
4-30-50	.55	.24	.14	.15
5- 1-50	.31	.14	.22	.21
5- 2-50	.51	.21	.17	.22
5- 4-50	.36	.19	.18	.26
5- 5-50	.31	.15	.15	.17
5- 8-50	.34	.13	.11	.14
5-12-50	.28	.11	.17	.15
5-15-50	.59	.36	.13	.13
5-18-50	.27	.09	.12	.11
5-19-50	.40	.16	.10	.11

two samples. It is commonly thought that dichloramine is a more reactive substance than monochloramine so that this result is perhaps unexpected. On the other hand, the differential titration is itself based on the fact that monochloramine reacts much more readily with iodide ion than does dichloramine. It is possible that other compounds (some of which may exist in a water supply or, as part of the distribution facilities) are in contact with such water which reacts more readily with monochloramine.

This change in relative concentration of monochloramine and dichloramine may be related to the decrease in the ammonia-nitrogen content of the water as it proceeds through the system. At Brantford after traversing three miles of pipe the ammonia content usually drops to about one-quarter of its original value—time of travel, approximately *2* hours.

In this regard it is important to realize that identical samples taken from the plant sampling tap then stored in the dark in glass bottles show an entirely different history as compared to the same water passing through piping for a brief two hours. The laboratory-stored samples take days rather than hours to show proportionate changes in the amount and nature of the chloramine and of particular interest is the remarkable stability of the ammonia-nitrogen content of such samples showing very little decrease in three weeks whereas the same water shows a *75* per cent decrease in NH_3 content in *2* hours in the system.

Metals, as Palin suggests, may be the answer as also may be slime, nuisance organisms, and the like. We do not have the answers to questions posed by these conditions but certainly the differential titration along with the ammonia determination has shown that these changes do take place and may finally give us the clue with which to solve water quality depreciation in distribution systems.

Research

It is suggested that those interested in conducting "break point" investigations on raw water conduct the following experiment:

Using a series of chlorine dosages arranged to straddle the "break point," make three identical sets of samples in the usual way for chlorine demand determination.

After a suitable retention period analyze one set by means of the "OTA" procedure of 9th edition "Standard Methods," the second by the amperometric procedure widely used until recently and the third, by the new amperometric procedure as described herein.

In the first set by OTA the normal rise and drop in residual will be found but early in the series before the "break" a pseudo free chlorine reading will be found in view of the inherent errors of acid orthotolidine. After the break little true information regarding the combined chlorine present will be found particularly as the total residual approaches *2* ppm. In the second series by the ordinary amperometric procedure sharp differentiation between free chlorine and combined chlorine will be shown. There will be no pseudo free chlorine due to any inherent errors and after the break the difference between free chlorine and combined chlorine will be sharply defined.

In the third series the differential titration increases insight into these reactions by expressing the combined chloramine separately as monochloramine and dichloramine. Speaking of one particular series, the author found by means of the differential titration two peaks prior to the break. The first peak was monochloramine (plenty of NH_3—very little Cl_2) which as it began to descend in the series was matched by the appearance and final rising to a second peak of almost all dichloramine (NH_3 still present but infinitely more Cl_2 present). Later, as both the monochloramine and dichloramine peaks had petered out, free chlorine asserted itself with the classical 45° rise in evidence. In the particular series in question the aeration procedure described previously was used in conjunction with the amperometric titrator to estimate NCl_3. NCl_3 made its appearance soon after that of free Cl_2 and continued to rise throughout the series fairly well in proportion to the rise in free Cl_2.

Such work is best visualized by expressing the results of all three sets of samples as graphs.

Conclusion

This author concludes that the outstanding work of Palin has given us a basically useful procedure which is marred only by certain conditions involving neutral orthotolidine; conditions which may not be of any significance in water in England at their average lower temperatures but which in our warm summer water are such as to preclude the use of his procedure.

Marks and his associates encouraged by Palin's work and no doubt by his criticism, have adapted almost identically the same set of analytical conditions to use in an amperometric titrator. This has given us a modified amperometric procedure by which hypochlorous acid, monochloramine, and dichloramine can be precisely and quantitatively separated.

It is also obvious that the use of this procedure has already broadened our knowledge regarding the various chlorination procedures and will no doubt continue in this respect.

References

The complete list of references appeared with the first installment of this article.

Tom Cole Establishes Water Laboratory Service

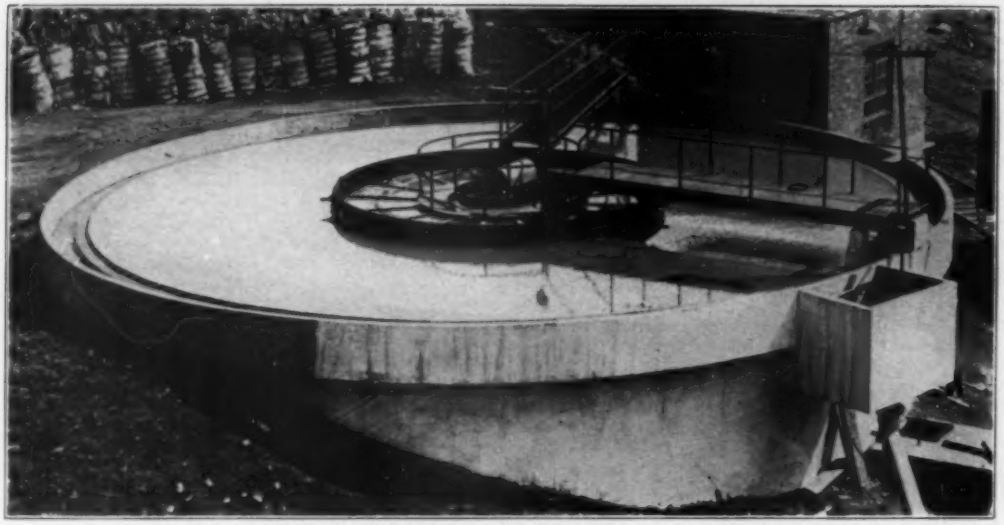
Thomas A. Cole, former bacteriologist and superintendent of filtration at Poughkeepsie, N.Y., is establishing his own laboratories for water analyses and supervisory services in water treatment.

Mr. Cole retired from his position at Poughkeepsie after 35 years service to the city and 44 years of combined water works service to Auburn, N.Y., and Poughkeepsie. He is a native of Poughkeepsie and became connected with the city's filtration plant in 1906. In 1909 he introduced chlorination and consequently was a pioneer in this. His records of the quality of the Hudson River water from 1908 through 1950 were recently used by N.Y. City in evaluating the river as an auxiliary emergency supply for the city.

Low Dams

(Design and Maintenance)

Is the title of a manual of design for small water storage projects. Representing a pooling of interests, and efforts, of several Federal agencies concerned with low dams. The manual deals with types of low dams; construction, operation and maintenance of such dams. It also gives information on associated subjects. Containing 431 pages and numerous illustrations, this manual (Catalog Y-3N21/12.2D) is available for $2.00 per copy from The Supt. of Documents, U. S. Gov't. Printing Office, Washington (25), D.C.



INFILCO CYCLATOR at mill of Raisen River Paper Co.

Handling Overflow Waters From Paper Machines

by HARRY W. GEHM, *Technical Advisor, National Council for Stream Improvement, The Pulp, Paper and Paperboard Industries, Inc., New York City*

PAPER machine overflow waters fall mainly into four classes. These are:

1. Processing new pulp into paper products.
2. Processing of old papers into board products.
3. Processing of pulp combined with fillers into paper products.
4. Processing of partially washed new pulp produced on location to board products.

New Pulp

Stream pollution problems arising from the first type of operation result from the discharge of suspended fiber only. Tissues, glassine, wrapping papers and some specialties fall in this classification. The content of dissolved organic matter is very low, hence, the discharge his little oxygen demand other than that of the fiber itself. Examples of the losses from mills of this type are in lb. per ton of product. (See table col. 2)

Mills of the type in this list recirculate to a practical degree and are equipped with screen-type savealls. High degrees of recirculation are feasible with some waters of this type, since the low dissolved organic matter content allows high effectiveness of slime control germicides. With others, such as insulating papers, this is not possible since electrolyte content must be kept low.

While fiber loss is not high, that lost is generally very fine in character. This makes its retention difficult and separation from the machine water overflow requires the use of high efficiency clarification equipment. The major objection in respect to the discharge of these types of machine water occurs in cases of low dilution where the receiving water is rendered turbid. Stream deposits seldom result from this waste because it is so finely dispersed, hence does not settle at reasonable stream velocities, is incapable of compaction even when settled and is rapidly oxidized in receiving waters.

	Lb. Sol. Sub. per Ton	Lb. B.O.D. per Ton
Kraft Paper	5	5
Glassine	15	5
Tissue (Sulfite)	40	10
Tissue (Sulfite and Groundwood)	60	15

Savings obtainable from the recovery of this fiber seldom justify the installation of equipment capable of salvaging it together with the cost of its operation and accessory costs such as added slime control measures required which arise in respect to its reuse. Thus clarification of such machine waters can be looked upon as a waste treatment measure.

In most common use for clarifying machine waters of this type to a high degree are flotation savealls. The advantage of such devices for this job over others is that the fiber is collected in a relatively high concentration and is returned to the system with sufficient rapidity that decomposition or sliming does not occur to a disastrous degree. These savealls are capable of doing a satisfactory job, if capacity is adequate, installation proper and control good. The major limitation of all

such devices is their sensitivity although this can me greatly improved by careful installation. Recent devices marketed for this purpose are filtration machines employing diatomaceous or pulp filter aids. These have the advantage of providing a barrier through which the waste water must pass and are not subject to upset. Hence, they can deliver continuously, a water of a quality which can be reused in part on showers and similar machine appertenances which can not operate on water containing appreciable suspended matter at any time. However, installation and operation costs of the filters are decidedly higher than for flotation units.

Both flotation and filtration devices have demonstrated their ability to reduce the suspended solids content of machine waters of this type below 50 ppm. and the loss below 5 lb. per ton of paper produced. This figure does not, however, represent total loss by the mill since flow drains and overflows contribute some additional continuous loss and intermittent losses occur on changeovers and wash-ups. The level of 5 lb. per ton represents the practical optimum degree of clarification obtained by sewage treatment processes. The table presented below shows typical results in lb. of suspended solids in the effluent from filtration and flotation systems operating on machine water discharged from various types of production.

	Susp. Sol. Lb. per 1000 gal of effluent	
	Filtration	Flotation
Kraft paper	0.05	0.08
Glassine	0.05	0.09
Tissue	0.21	0.20

It appears, therefore, that such stream pollution problems as may arise from the discharge of machine waters of this type can generally be remedied by the installation of a suitable clarification system integral with the mill operation. Further external treatment of the discharge could accomplish nothing in view of the efficiencies obtainable and the fact that recovered residues can generally be incorporated in the product.

Old Paper

The second class of machine water is that produced from the manufacture of board products largely from used papers and boards, mainly news, carton and various heterogeneous mixtures. Water discharged from this operation varies in character due to the types of stock employed, the product manufactured and the degree of recirculation of white water within the mill. The volume of effluent per ton of product varies between 5000 and 20,000 gal. per ton although a few mills by means of unusual procedures have reduced this to as low as 1000 gallons. Average discharge for a mill employing savealls and recirculating white water to stock preparation and cylinder showers is about 10,000 gals. per ton of product.

Most stream pollution difficulties arising from this waste result from the discharge of fairly coarse suspended matter which is largely fiber and other organic debris. A large portion of this will settle at low stream velocities, causing the usual problems associated with organic benthal deposits. In addition to the settleable suspended solids, this waste contains some dispersed matter as well as considerable dissolved organic matter arising from sizing and adhesives as well as products of cellulose hydrolysis and other impurities carried in the old paper.

Analysis of the effluents from a large number of mills employing a degree of recirculation and simple savealls indicates that suspended solids discharged per ton of product varies from 35 to 70 lb. and B.O.D. (5-day) from 15 to 30 lb. From 70 to 90 per cent of the suspended matter is settleable without the addition of coagulants. Reasonably low dosages of alum will cause settling of practically all the the suspended solids. Removal of substantially all the suspended matter results in a reduction of from 20 to 35 per cent of the B.O.D.

Because of the fact that the bulk of the suspended solids can be removed by settling and the addition of alum produces a clear effluent, this method of treating news and chip board machine water is most generally employed although others are in use including vacuum filters, flotation devices and recently, filters pre-coated with pulp or diatomaceous filter aids. Sedimentation is the least costly method of removing the solids and three general classes of tanks are employed. These are as follows:

(1) Basins or conical bottom tanks not containing a sludge collector mechanism.

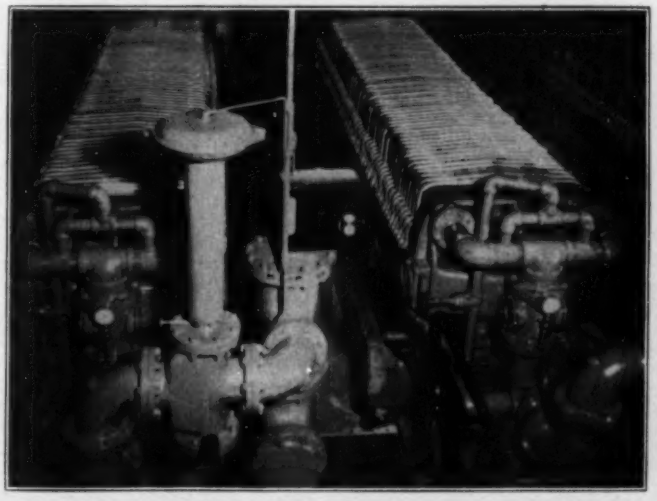
(2) Clarifiers of the thickener type having mechanical sludge collectors.

(3) High rate clarifiers of the up-flow type in which the waste flow filters through a suspended blanket of sludge.

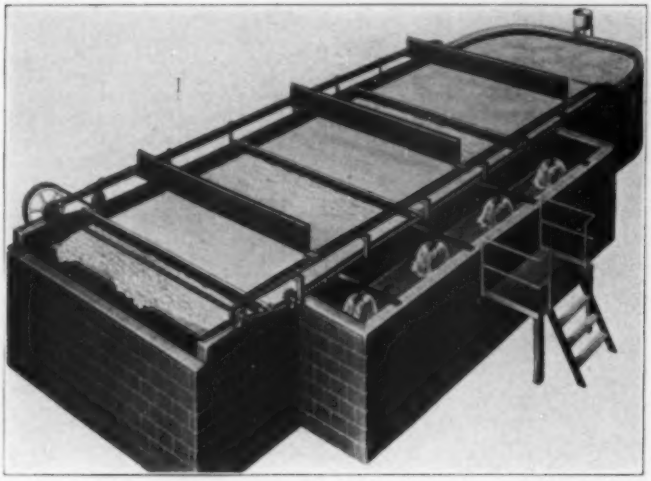
The first of these designs is most satisfactory where complete clarification is not necessary and coagulants are not used. In order that sludge removal functions satisfactorily, the hopper bottom should have as steep a slope as possible, a minimum of 60 degrees being desirable. Provision should be made for removing entrained air from the feed and continuous sludge removal at a slow steady rate arranged in order to prevent decomposition and sliming of the sludge and allow withdrawal at high density. A two-hour detention period at maximum flow will yield optimum results.

Thickener type clarifiers operate well both with and without coagulants although when coagulation is employed care must be taken to operate the collector in a manner which will prevent stagnation of the sludge in the tank and at the same time allow good thickening. Generally this type of clarifier is designed on the basis of a two hour detention period at maximum rate of flow.

The third, or high rate type of clarifier is employed to advantage only when the waste is coagulated. Since



OCO FILTER installation at Ohio Boxboard Co. mill employs diatomaceous filter aids.



FLOTATION SAVEALL (Sven-Peterson) of Bulkly, Dunston Pulp Co.

the waste flow filters through a blanket of sludge suspended in the body of the tank an exceptionally clear effluent can be produced at detention times and overflow rates as low as one-half that of the usual thickener type clarifier. With this added efficiency goes greater sensitivity to fluctuations in temperature, flow, feed strength and chemical dosage. Hence installation must be carefully made and operation good, if the advantages possible with units of this type are to be realized. Early models of these devices had the disadvantage of delivering a low density sludge but this trouble can be largely overcome by including thickening devices integral to them.

While clarification of these machine waters present no major problem, handling of the sludge obtained is not generally as readily accomplished. In some cases, depending on the type of used paper processed and operating conditions, this sludge can be returned to the system and incorporated in the product completely; in others only partial return is possible and in some cases it must be disposed of completely. The common method of disposal is lagooning in earth embanked basins. These are filled with sludge which is allowed to compact following which supernatant water is siphoned off. The residue is allowed to dry to a degree where it can be handled, at which time it is collected by means of a bulldozer or drag line and hauled to dumping grounds. Appreciable land must be available in undeveloped areas for this purpose. An excellent summary of dewatering and drying qualities of such residues upon which actual requirements can be based was presented by Vogler and Rudolfs in the Purdue Engineering Bulletin Series 72.

Paper With Fillers

The third class of machine waters listed above are those produced by the manufacture of ledger, book and similar papers containing appreciable quantities of filler materials such as clays, calcium carbonate or calcium sulfate. In many of these waters the quantity of suspended filler approaches that of fiber and since the filler particles are extremely finely divided, rapid separation from the water is not readily accomplished.

Summarized data covering numerous mills indicate that the overflow water contains from 50 to 120 lbs. of suspended solids and 10 to 25 lbs. of 5-day B.O.D. per ton of product. Between 50 and 70 per cent of the suspended solids are volatile.

Until recently, flotation type savealls were used almost exclusively for clarification of this type of water. Alum in conjunction with glue or resin size must be added to obtain high degrees of clarification. In some cases, fiber has also been added to the feed in order to insure a sufficiently high fiber to filler ratio to allow adherence of the filler and maintain a balance in the slurry returned to the machine. Sensitivity is the major shortcoming of the flotation systems operating on these waters since variations in flow, suspended solids, injected air, chemical dosage and fiber to filler ratio all effect the degree of clarification obtained. When operating in balance, these devices produce effluents containing between 20 and 50 ppm. of suspended solids, and they return, with dispatch, a relatively dense slurry to the machine system.

Recently, attention has been given to the application of high rate upflow clarifiers to these waters. There is little reason to believe that these will prove any more satisfactory than the flotation units. In all probability, results, operating characteristics, installation and operating cost of the two will prove similar.

Partially Washed Pulp

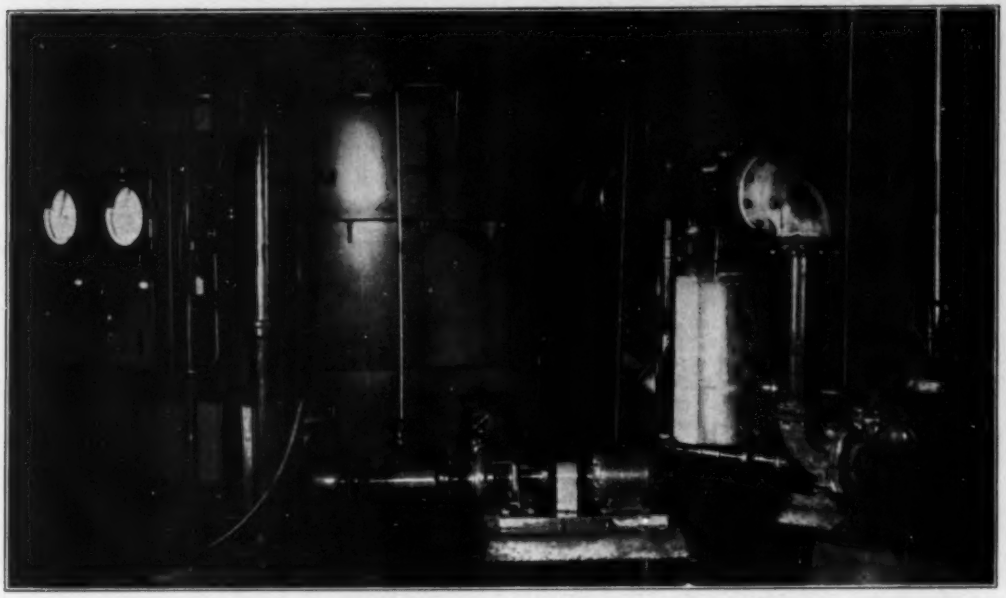
The fourth and last class of machine waters are those containing appreciable quantities of dissolved solids in the form of cooking liquor residues. Strawboard and semi-chemical boards are examples of this group. In these processes the pulp is often incompletely washed prior to delivery to the machines. Since the presence of liquor solids serve as food for slime batceria and inhibit the activity of germicides, recirculation of the machine water to a high degree in the stock system is not practical and fresh water must be employed for the showers.

Typical analysis of these white waters are presented in the following table:

	ppm. Susp. Solids	ppm. B.O.D.
Strawboard Machine Water	940	430
Saveall Effluent	480	310
Semi-chemical Machine Water	745	1015
Saveall Effluent	290	890

Saveall devices employed in mills of this type are of the screen variety and since the fiber reaching them is generally finely divided removal efficiencies are not high. More efficient clarification devices are not practical because of rapid sliming in recovered slurries, the finely divided nature of the recovered residues and the high and rapidly varying coagulant demand induced by the presence of liquor solids.

Three methods have been employed for removing the bulk of suspended solids from these wastes. The first necessitates a complete change in the manufacturing process wherein the pulp is washed to a high degree on vacuum filters prior to delivery to the machines. The other two are strictly disposal systems, the older of which being the sedimentation lagoon similar to that employed for news and chip mill waters. More recent is the application of lime precipitation in a clarifier of the thickener type. This system has not met with much success because the underflow discharged from the clarifier is highly hydrous and resists further dewatering even on the addition of impractical dosages of conditioning chemicals.



BIRD-GIBBS UNIT at mill of Fitchburg Paper Co.

Change in manufacturing process is the most desirable method but is limited to only a few operations because of high cost and physical limitations. Lagooning method has been successfully applied where suitable land was available and proper attention given to operation. Lime precipitation has been a practical failure.

Summary

In summing up the machine water problems; it can be said that:

(1) Very substantial progress has been made by the pulp and paper industry in reducing suspended solids discharged by paper machine operations.

(2) New Equipment and processes are constantly being developed which are leading to the discharge of effluents as low in suspended solids content as highly treated municipal sewage effluent.

(3) Recovery of fiber and filler beyond a certain point is not profitable but imposes an actual cost on the overall manufacturing operation.

(4) Clarification of some machine waters imposes a disposal problem in that residues separated from the water are not suitable for reuse or on reuse interfere with the manufacturing process in one manner or another or reduce product quality.

(5) In the case of some machine waters, clarification alone is not sufficient to remove all the objectionable characteristics since the color or oxygen demand imparted to receiving waters by dissolved solids present in them, can under some conditions, result in surface water problems.

(6) In many cases, particularly with high rate units, proper installation and good operation are more important than the type of equipment employed as far as results are concerned.

F. W. Kittrell Joins Atomic Energy Commission

F. W. (Kit) Kittrell, for the past nine years in charge of Stream Pollution Studies for the TVA at Knoxville, has left that position to become a Sanitary Engineer on the staff of the Atomic Energy Commission at Oak Ridge, Tenn. He will work particularly with state agencies in radiation safety measures connected with the use of radioactive isotopes.

A native of South Carolina and a graduate of North Carolina State College, Kittrell held one of the Hershel Award Scholarships at Harvard University where he took a Master's degree in Sanitary Engineering in 1933. Prior to his work with TVA, Kittrell spent eleven years with the Tennessee Dept. of Health, some time with the Potomac River Basin Comm. and five years with Standard Oil of Indiana at the Whiting Refineries.

Kittrell has authored or co-authored nearly a dozen technical articles, one of which on "Natural Purification Characteristics of a Shallow Turbulent Stream" won him the Harrison P. Eddy Award of the Federation of S & IWA in 1947.

Active in several technical societies and associations, Kittrell is Secretary of the Water Resources Division of AWWA.

Making Cellars Dry

Is a booklet which describes methods of avoiding dampness in cellars by proper construction and ways of alleviating dampness in cellars already built. Inexpensive at 10 cents per copy, this 28 page guide to dry cellars is available as Catalog A-1.9: 1572/2 from the Supt. of Documents, U.S. Gov't. Printing Office, Washington (25), D.C.

A WATER & SEWAGE DIGEST

Determination of Toxic Materials in Water Supplies

by C. C. RUCHHOFT, W. A. MOORE, F. M. MIDDLETON,
U. S. Public Health Service, Cincinnati, Ohio

THE determination of toxic materials in water supplies confronts the chemist with elusive and difficult problems. It is important that the analyst be able to make accurate determinations on very small quantities of material. Concentrations of toxic materials in drinking water may range from a few micrograms per liter up to several milligrams per liter or more. Methods are frequently not available for the determination of toxic materials in water in the quantities encountered.

The determination of the inorganic ions considered important from a toxic standpoint by the Public Health Service Drinking Water Standards will be considered in the first part of this paper. The second part of this paper describes the effects and determination of certain organic materials that are found in water supplies. A method recently developed at the Environmental Health Center Laboratories for the recovery of small quantities of organic chemicals from raw and finished water is also described.

Determination of Inorganic Ions

The Drinking Water Standards of the Public Health Service place specific limits on the occurrence of certain ions in the water supplies of interstate carriers. They also suggest limits on other ions which commonly occur or may on occasion occur in such water supplies. These ions will be considered under three divisions:

1. Ions on which specific limits have been placed. These are: arsenic, hexavalent chromium, fluoride, selenium, and lead.

2. Ions for which specific limits have been suggested. These are: copper, magnesium, sulfate, chloride, and zinc.

3. Toxic ions occasionally encountered in water supplies. These are: boron, nitrates, beryllium, and cadmium.

Organic Materials of Importance in Water Supplies

Organic wastes in surface waters may come from a variety of sources and it is important to know the effect of the various organic constituents of wastes on the stream. One method of studying such effects is to determine the persistence and dissimilation of stream contaminants under various conditions. Phenol, o-cresol and m-cresol, in 1 p.p.m. concentrations, have been found to be biologically dissimilated at 20° C. in one to seven days under aerobic conditions. At 4° C. the same compounds require from five to nineteen days for complete dissimilation. Biological dissimilation of these phenolic compounds also takes place under anaerobic conditions, although generally at a slower rate. Ortho and parachlorophenol may also be attacked by biological agencies in surface waters. This dissimilation may require 20 to 30 days at 20° C. or more under certain conditions.

Cyanides are known to be among the most toxic compounds in our environment. From .02 to 0.5 p.p.m. may be toxic to certain fish and concentrations of one to two p.p.m. are usually fatal to fish life. In polluted waters, such as the Ohio and Great Miami Rivers, organic matter is biochemically oxidized in the presence of cyanide after an initial lag period. In concentrations up to 6 p.p.m. of cyanide, approximately 50 per cent of the B.O.D. of domestic sewage was recovered. At a concentration of 25 p.p.m., only 14 per cent of the B.O.D. was recovered and at a concentration of 50 p.p.m. cyanide the B.O.D. recovery was less than 1 per cent.

Waste from synthetic rubber industries, a problem we are likely to encounter soon again, is objectionable because of B.O.D. contribution and taste and odor-imparting qualities. The odors from butadiene and styrene wastes are quite resistant to natural purification and to most water treatment processes. Activated carbon will remove the odor but 100 p.p.m. or more may be required. Breakpoint chlorination may be effective in reducing the odors if the quantity of the waste is below 0.5 to 0.9 per cent for styrene and 3 per cent for butadiene.

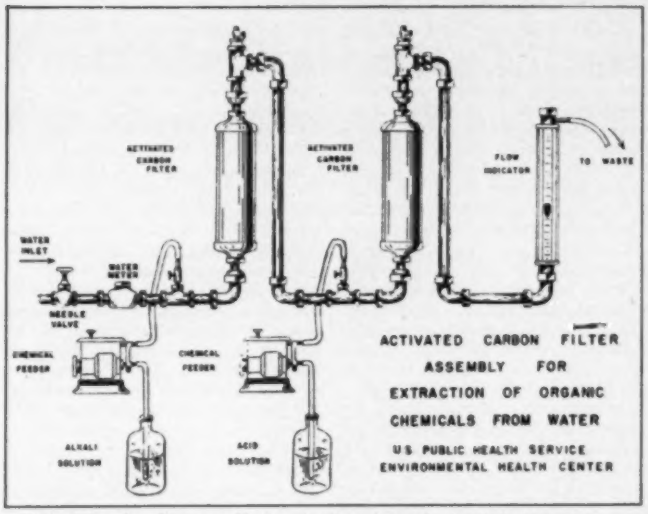
A method commonly used in determining the concentration of organic material in industrial wastes and polluted waters is the oxygen consumed procedure. There have been a number of procedures proposed for this determination, all of which unfortunately are not particularly designed for the determination of low concentration of organic compounds. A comparative study of these methods has shown that the dichromate procedure proposed by this laboratory will give the most reproducible results.

Collection and Separation of Organic Chemicals

Minute, but objectionable, quantities of organic chemicals in surface or finished waters cannot usually be quantitatively determined by ordinary chemical analytical methods. The chemicals causing taste and odor in water supplies may be present in concentrations of only a few parts per billion. In order to recover sufficient quantities of these organics for examination, some method of

Water & Sewage Works is privileged to publish, in digest form, the important papers which were presented at the 1951 Inservice Training Course in Water Works Problems at the University of Michigan.

We believe these digests will adequately serve the interests of many of our readers. Those who wish to have the complete text of the papers can procure the printed "Proceedings" for two dollars by addressing Mr. H. E. Miller, Director, Continued Education, School of Public Health, Ann Arbor, Mich.



Activated carbon filter assembly for extraction of organic chemicals from water.

concentration is necessary. Our laboratory in Cincinnati has devised a means of recovering organics from water by absorption on activated carbon, followed by elution with an organic solvent. Portable field filters, consisting of a three-foot length of four-inch pipe, are filled with activated carbon. The carbon is held in place by perforated plates in the reducers at each end. For turbid waters the carbon filter is preceded by a portable sand filter that may be backwashed. For laboratory studies of finished (purified) water it has been found important to collect the samples under varying conditions of hydrogen ion concentration.

An arrangement for injecting acid or alkali ahead of the carbon filters is illustrated. It has been found that the recovery of organics under acid conditions in Cincinnati tap water is equal to the recovery of organics at the normal pH of the water which varies from 8.0 to 8.4. Water is passed through the filters at a rate of 0.5 gallon per minute or less until 5,000 to 50,000 gallons have been filtered. The carbon is then air dried and placed in a large capacity modified Soxhlet extractor. The carbon is extracted for several days with chloroform or ether. A large portion of the solvent is distilled off, the residue dried with anhydrous sodium sulfate and the final product is subjected briefly to vacuum desiccation to remove all solvent. The quantities of anhydrous organic extract recovered from various waters varied from 5 to 200 p.p.b.

The organic residue is separated into acidic, basic, neutral, amphoteric, and phenolic groups. Due to the small quantities of material available, semi-micro or micro techniques are used. The compounds isolated are of interest from the standpoint of taste and odor in drinking water.

Complete analysis of the materials extracted poses difficult analytical problems. Chemicals or groups of chemicals identified to date include organic acids, certain amines, neutral compounds, phenolics, pyridine, terpenes and pyrrole. The organic residue recovered is generally a brown, viscous odorous mass. The organic neutral compounds appear to be the largest group of compounds isolated. This group is characterized by a particularly offensive odor. Compounds of a terpenous nature are believed chiefly responsible for this odor but definite chemical identification has not been made. A very similar odor can often be noted in water supplies using the Ohio River as a source.

It is of interest that an extract from the water supply of Columbus, Ohio, considered to be unpolluted by industrial wastes, had a high threshold odor. This odor was distinctly musty as compared with the "painty" or terpenous odor from samples known to come from industrially polluted waters. Microorganisms such as algae or actinomycetes are believed to be related to such odors in water supplies but information is lacking as to the actual chemical constitution of the odoriferous materials. Most of the organic extracts collected show fluorescent properties under ultra violet light. It is known that many biologically active compounds have fluorescent properties. Whether the quantities of organic materials occurring in surface waters polluted by industrial wastes or by natural growths of microorganisms can have a toxic or other physiological effect on man or animals has not been explored. The technique presented will make available materials for such study. The fact that appreciable quantities of organic materials survive breakpoint chlorination and other water treatment processes warrants study.

Toxicology As Applied to Public Water Supplies

by C. W. MUEHLBERGER, *Toxicologist, State Dep't. of Health, Lansing, Mich.*

THERE are literally thousands of substances which could have a harmful effect on the human body if they found their way into the public water supply—either by accident or by willful sabotage. Like so many subjects, the consideration of poisonous effects is not simple. In many instances, a small amount of a substance may be beneficial or even essential, whereas larger amounts may have a toxic effect. The question of possible poisoning is centered around the matter of how much of a substance a person will receive. In the case of water, this value is determined by the concentration of poison and the quantity of water consumed. Thus, in the interest of health, it has seemed wise to set limits on the concentration of harmful substances in drinking water supplies.

One factor which must be considered in discussing human poisoning is that of variability. We readily recognize the fact that all persons are not equal with respect to their ability to withstand the effects of poison. In general, we may say that the greater the body weight, the less effect a measured amount of poison

will have. Age provides another factor, for poisons are more likely to affect babies and aged persons, than adults who are in early or middle age.

The body protects itself against poisons in two general ways. It eliminates the poison, either in its original form, or in a modified form in the excrement or breath; or, it alters the poison (usually through oxidation) to a less toxic or non-toxic substance.

Poisoning from the drinking of contaminated water is most likely to be of a chronic rather than acute type. Persons who drink contaminated water periodically throughout the day will be confronted with repeated small doses of the poison. If their ability to destroy or eliminate poison exceeds the rate of poison intake, then no harmful effect will be noted. The choice of a safe limit for a toxic substance in drinking water must be gauged, not by the effect on the average healthy person, but by the effect on infants, children or aged persons who are in a more susceptible condition. Furthermore, one must also make allowance for other common sources of poison intake—such as from insecticide residues which find their way into food or milk, dust-borne poisons such as lead from the exhaust of motor vehicles burning "ethyl" gasoline, etc. Thus, in setting a limit for the concentration of a toxic substance in drinking water, one should allow for a factor of safety just as an engineer employs a factor of safety in designing a bridge.

Safe and Unsafe Limits

Many of these limits are based largely upon bitter experience. We have found by trial and error methods that 0.1 part per million is a safe limit for lead—judging from experience with water passing through lead conduits. Likewise, we have acquired information on the danger of arsenic from accidental exposures such as the Manchester beer poisonings. During the period 1899-1900 a large number of chronic arsenic poisonings which occurred in Manchester, England, were finally traced to the drinking of beer which was contaminated with 2 to 4 parts per million of arsenic. In the southwestern part of the United States, the mottling of dental enamel in children was traced to excessive amounts of fluoride in the water supply. No cases were observed where the fluorine ion concentration was less than 1.5 parts per million. Limits for copper, and zinc (10 to 20 parts per million), and hexavalent chromium (0.05 part per million) are not based upon such experience or upon adequate experimentation. Copper and zinc appear to be so poorly toxic that in concentrations which do not impart an unpleasant taste to drinking water, they have no toxicological significance. They are in much the same class as iron, aluminum, nickel or manganese. Sulphides might exert a toxic effect, but in toxic concentrations they impart such an unpleasant taste and odor to a water supply that there seems to be little danger of poisoning.

There are a few other substances which may contaminate a water supply to a dangerous extent. Electroplating solutions dumped into streams or areas where they may contaminate a well, may give rise to dangerous amounts of chromate and cyanide. Traces of cadmium might arise from the use of cadmium plated pipe or fittings. Insecticide residues and vermin exterminators may introduce phosphate esters, chlorinated hydrocarbons or thallium. And in one area of our country, selenium might possibly be found as a contaminant.

Obviously we cannot estimate the hazard of a toxic substance by using human "guinea pigs." We must start first with lower animals—fish, mice, rats, guinea pigs and rabbits, observing the rate at which these animals absorb and eliminate the toxic substance. Then we would experiment with dogs, cats and finally monkeys, making similar observations. In all experiments it is important to have a similar group of animals as "controls." Finally, when a concentration of poison is found which is just too low to cause indications of poisoning, animals are kept on such drinking water for a long period of time and later killed and examined both pathologically, to see if there is any deterioration of the vital organs due to the poison; and chemically, to see if there is any accumulation of poison in the body.

The final answer is always a carefully controlled human study. A group of human volunteers take measured amounts of drinking water containing a supposedly "safe" concentration of the toxic substance. They are carefully watched for any indication of the type of damage observed in higher animals. Likewise careful analyses are made of all excreta to determine the rate of which the toxic substance is eliminated from the body. In this way a reasonably accurate safe limit may be established. Applying a factor of safety, this limit is reduced to a maximum tolerated concentration for drinking water supplies. A limit so established should afford protection for all.

Municipal Sewage Treatment Processes

A Motion Picture—

The Communicable Disease Center (Atlanta, Ga.) of the Federal Security Agency has recently released a 470 ft. black and white motion picture, with sound on "MUNICIPAL SEWAGE TREATMENT PROCESSES." The film which will run for 13 minutes will depict basic methods of sewage treatment. The film has been prepared especially for Public Health Sanitarians and professional trainees in schools of Public Health and Engineering.

The film shows and explains how the largest solids are intercepted and removed from the sewage, how suspended materials are removed, how oil and grease are skimmed from the surface, how dissolved matter is biologically oxidized either by the trickling filter or by aeration, and how the biologically treated liquids are clarified, chlorinated and then discharged into streams.

It shows how sewage solids are transferred to a heated sludge digester and how the digested sludge either is dried on sand beds or is coagulated and vacuum filtered, dried and burned or used as a fertilizer. Laboratory test control is also depicted.

Related CDC productions are two motion pictures: M65, Better Sewage Treatment and 4-078, Sewage Treatment; four filmstrips: Municipal Sewage Treatment Plants (Series), 5-138 Part I—Primary Treatment Plants, 5-158 Part II—Chemical Precipitation Plants with Two Stage Digestion, 5-159 Part III—Trickling Filter Plants, 5-160 Part IV—Activated Sludge Plant with Vacuum Filtration and Incineration; and a set of 259 2"x2" lantern slides embodying the pictures in the four filmstrips of the Municipal Sewage Treatment Plant Series.

This film can be purchased through United World Films Inc.; or, prints of the film are available on short loan, without charge, from the Communicable Disease Center in Atlanta, Georgia.

"A Coordinator"

An individual who can regiment chaos out of organized confusion.

Portable Diatomite Filters For Emergency Use

An article based on two and one half years of study of factors affecting the design and operation of diatomite filters.

by DEWARD M. MARTIN,* *Univ. of Illinois, Urbana, Ill.*

DIATOMITE filters are recommended as one of the least expensive and most economical types of portable filtration equipment available. Diatomite filters are light, sturdy, relatively cheap to operate, and produce a filter effluent which is comparable to, or better than, that from rapid sand filters. These filters are available in a range of sizes sufficient to meet a variety of conditions.

Because of the adaptability of diatomite filters to unusual conditions, they can be used in almost any water supply emergency to meet the essential needs of a community. The initial cost of such emergency filtration equipment is not excessive and the operation of the equipment is relatively simple. A survey of the types of portable equipment available has led to the recommendation that diatomite filters be used for emergency filtration of water supplies.

All communities having municipal water supplies and located within a region selected as a basis for cooperation could organize a program for the use of emergency filtration equipment. This equipment would be available to any municipality in the region, in time of emergency. If enough portable filter units were secured and located in the proper places, at least one unit could be rushed to almost any community in a matter of a few hours, and other units could follow. These filter units should be located in areas of frequent flood, storms, earthquakes, areas of great strategic value in time of war (such as industrial centers manufacturing war materials) and other areas likely to experience emergencies.

Diatomite Filters

Diatomite filters are available in sizes ranging from 0.5 sq. ft. to 150 sq. ft. of filter area. The optimum rate of flow through such filters ranges from about 1 to 300 gpm. Thus, two filters with 150 sq. ft. of filter area each operating at an average rate of only 1 gal. per minute per sq. ft. of filter area could supply almost a half million gallons daily. The same two filters could be operated with much faster rates to give several hours of flow of from 300 to 1000 or more gals. per minute.

The cost of a typical filter unit sufficient for municipal use varies from about $125 for a 0.5 sq. ft. filter to about $2000 for a 150 sq. ft. filter. The operating cost for a 25 sq. ft. filter, operated under optimum conditions, is about $5.00 per week. The operating cost per sq. ft. of filter area decreases with increase in size of the filter unit. Extra equipment which can be used to make filtration with diatomite filters more efficient, but which would not be essential in an emergency installation, includes a slurry feeder for the diatomaceous earth, the cost of which varies from about $200 to $800, depending on the size of the unit.

Portable diatomite filters may either be truck-mounted or unattached. The unattached units are supplied with flexible hose for connections to the pump and to the influent and effluent lines. The unattached are made with supports so that they will stand on any hard flat surface; therefore they may be used in almost any situation or location. These units do not have included a slurry feeder for applying the body coat (filter membrane) to the filter. The pump and the motor for driving the pump are separate from the filter. The truck mounted unit consists of a filter, a separate slurry feeder, a pump, a motor, and possibly a pre-coat tank, all mounted on the body of a truck and connected so that the unit is ready for use. The motor for use with portable filters should be some readily portable combustion engine.

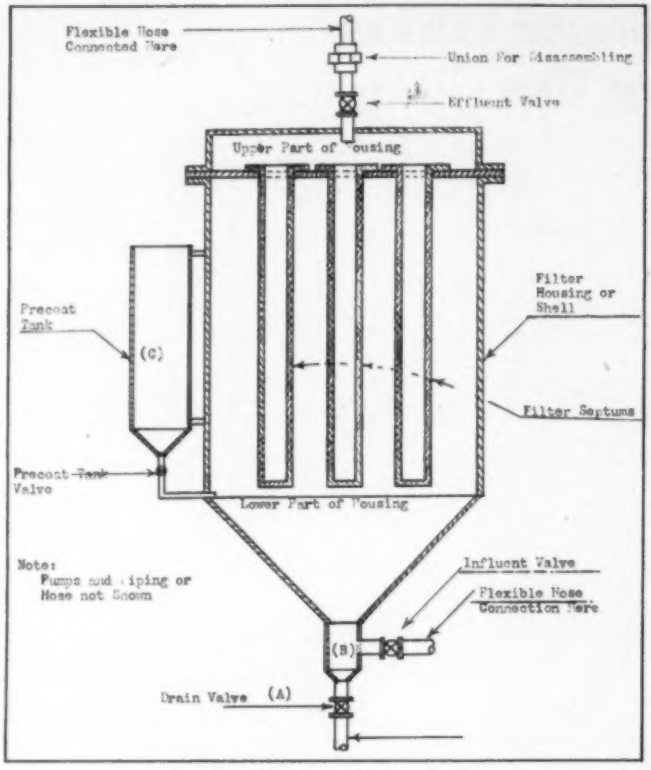
One advantage of the truck mounted unit is that it is ready for immediate use, whereas the unattached unit must be connected on the scene. The truck-mounted unit can be operated more economically because of the increased length of filter runs made possible by the use of a slurry feeder for body coat. However, truck mounted units are not recommended for emergency use because of the fact that the first costs are greater than for the unattached unit and because of the fact that a truck must be tied up with a filter unit which may not be used more than once in several years. It seems advisable to use the unattached units and to transport them to the scene of the emergency with trucks made available at the time.

It seems reasonable that most people connected in any way with the water supply of a municipality realize the need for some type of emergency filtration equipment. It may not be immediately apparent to many of them just why diatomite filters are to be preferred over other types. It is reasonable to assume that sand filters could not be used in emergencies as portable filters because of their tremendous weight and bulk. A sand filter which will give a gpm rate of flow equivalent to that of a diatomite filter weighs from 15 to 20 times as much as the diatomite filter. Other types of portable filters are more prohibitive in cost than diatomite filters because of the fact that diatomaceous earth, used as a filter aid in diatomite filters, is low in cost. Another advantage of diatmoite filters is that the head loss through the diatomaceous earth filter membrane is low. Diatomite filters also give a reduction of color, turbidity, and bacterial count in the water, which is equal to or better than that from the most efficiently operated sand filters.

The accompanying diagram shows a cross-sectional view of a typical portable diatomite filter unit, shown without supports or means of attachment. It should be understood that the filter shown in the diagram embodies only the basic and simplest principles. In practice, specific and much more advanced types of filters could be selected.

The essential parts of a diatomite filter are the housing, the filter elements, a precoat tank, a drain line, influent and effluent lines, and some type of backwash. The filter housing is usually cylindrical, the height of the unit often being twice the diameter of the housing. The housing is ordinarily made of stainless steel, alumium alloys, bronze, or other corrosion resistant materials, though it is concievable that plain soft iron housings could be used for short periods of time during an emergency. The housing drain is usually in some such position as that shown in (A) of the accompanying diagram.

*Research Assistant in Civil Engineering.



DIATOMITE FILTER—typical cross-section

Operation of the Filter Unit

In operation, water from a supply enters the bottom of the filter housing at (B) and flows upward into the lower part of the filter housing. There the water flows from the outside through the filter membrane to the inside of the filter septums and out at the top. The septums are connected to a plate which separates the upper and lower parts of the filter housing. The connections are such that only the filtered water is allowed to flow from the inside of the filter septums into the upper part of the filter housing. When using diatomite as a filter aid (and diatomite filters should never be operated without filter aid because of clogging of the filter septums), the filter aid is added to the water and coated on the septums at the beginning of filtration. The filter aid must be applied first so that all of the water passing through the filter septum must first pass through the coating of filter aid.

The filter aid is usually added by placing it in the precoat tank (C) as a slurry of about 2 or more parts of water to 1 part of diatomaceous earth. The slurry flows into the bottom of the filter housing and is carried to the outside of the filter septums by the force of the first water to be filtered. It cannot go through the openings in the septum (except in the case of very porous septums, and then the amount is very small), and is lodge on the septums to form a porous filter cake. The water to be filtered must pass through the layer of filter aid, and in so doing exerts a pressure to hold the filter aid in place throughout the operation. As the filtration progresses, more filter aid may be added in the form of a very dilute slurry to the unfiltered water. Filter aid added in this manner is known as "body coat" and is not absolutely essential, even though it gives greater economy in operation of the filter.

The filtered water passes through the upper part of the filter housing and out to the distribution system or to a fresh water storage tank. When the filter has been in operation long enough for excessive clogging of the filter cake to occur, the filter aid is washed off and a new coat applied. If a filter is properly operated, the filter aid precoat may be clogged, backwashed, reapplied, and clogged again many times without necessitating cleaning of the filter septums by more strenuous methods. Several types of backwash for removing the filter aid coat are in use but most all of them involve removal by forcing water in the reverse direction through the filter septum. Some methods of backwash utilize the force of entrapped or compressed air to force water in the reverse direction with tremendous force, thus giving very effective cleaning of the filter septums.

The filter septums used in diatomite filters may be any one of the many types now commercially available. Among the septums now available are included septums of porous stainless steel, brass, or bronze, porous carborundum or aloxite, septums with stainless steel wire wound on a core of lucite, stainless steel, brass, or bronze, septums with strips or ribbons of stainless steel wound on a skeleton framework of stainless steel, brass, or bronze, septums of cloth supported on wire core, and septums of a very fine wire mesh. The accompanying photographs show a few of the typical filter septums available for use in small filters.

The only necessary application of filter aid to the filter septums in a filter used in an emergency is the initial precoat applied at the start of filtration. A precoat tank, such as the one shown in the accompanying diagram, is sufficient for the application of the intial precoat. However, if a slurry feeder for applying very small amounts of solute to water is available and convenient, greater efficiency of operation can be secured by the use of a body feed of very small amounts of filter aid.

The mechanism by which the efficiency of operation is increased by the use of body feed is not thoroughly understood; however, it is generally believed that this effect is a result of maintained porosity of the cake of residue from the water. The residue from the water normally builds a cake covering the cake of filter aid deposited as the initial precoat, if no body coat is added during filtration. Without body coat, the residue cake soon becomes very dense and the head loss through the filter increases rapidly. The initial precoat must be backwashed often to provide a porous filter cake that will supply a capacity flow from the filter.

If a body coat is used, the effect of the body feed is to continually add a small amount of filter aid to the surface of the cake on the filter septum. The filter aid added as body coat is

SEPTUMS from Diatomite Filters. Porous types on left. Wire-wound and ribbon wound types on right.

interspersed with the residue collected from the water and increases the porosity of the residue cake. The amount of body coat needed is determined by the turbidity of the water, the more turbid water requiring greater amounts of body coat to provide the necessary porosity to the residue cake. The filter septum with which a body coat is used does not have to be backwashed until such a thick coat of filter aid has built up that the head loss through the cake is excessive. The length of time necessary for the cake to build up that much is far greater than the time required to clog a filter using only the initial precoat; therefore filter runs are much longer when body coat is used. The net result of the use of body coat is a saving of filter aid and the filtration of greater volumes of water per unit time.

Emergency Operation

When a diatomite filter is operated in an emergency, the rate of flow will probably be controlled by two principal factors; the number and capacity of filters available, and the amount of water needed. Flow rates in diatomite filters can be varied greatly, but with expense of filtering economy. The most economical operation of diatomite filters is reported to be secured with a rate of flow of 1 to 2 gpm per sq. ft. of filter area.[1] More water can be forced through the same filter aid precoat at a low rate of flow than at a higher rate. It has been stated[1] that the cost of operation of diatomite filters exceeds that of sand filters above a flow rate of about 3.6 gpm per sq. ft. of filter area. The possible maximum flow through diatomite filters can, however, be increased to many times that amount with the decreasing economy which accompanies such operation.

Diatomite

There are several brands of diatomaceous earth available for use as filter aids with diatomite filters. The various brands differ slightly in porosity, weight, and absorptive power, but the differences are not great enough to exclude any one of them from use in an emergency. All of the diatomaceous earth filter aids are made of essentially the same material, diatomite in some form.

Diatomite is a soft, earthy rock, varying in color from white through buff, green, gray, to brown. The white is most in demand. Diatomite was formed eons ago by the deposition of diatoms on the sheltered bottoms of the sea. The sea gradually subsided from the land and the continental rise finished the elevation of those deposits well above sea level. The deposits are now mined in almost pure state and are used for filtration purposes.

The outstanding features of diatomaceous earth include its great porosity and peremeability, low apparent density, relative chemical inertness, and a high melt-in point of about 1500 degrees F. Diatomite has a porosity of about 90 per cent by volume of minute air cells, and in its powdered form has an absorptive power of from three to four times its weight of water.

Within the last 25 years the development of diatomaceous earth filter aids has revolutionized filtering processes in the refining of all types of sugar, oils, cereals, fruit beverages, chemical serums, dry cleaning fluids, and liquid soaps. It is only during recent years that it has been used to a noticeable extent in the filtration of water. At the present time diatomite is finding some use in the filtration of water for swimming pools. Use of diatomite for filtering municipal water supplies has not been widely practiced yet, but the satisfactory results of such plants as the one at Cherry Valley, New York,[2] have indicated great possibilities for the use of diatomaceous earth filters for municipal water supplies and for emergency filtration equipment.

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1. "Pur-O-Cel" Filters, Proportioneers, Inc. Literature.
2. Diatomite Filters Turn Out Safe, Clean Water, Eng. N. Rec., May 18, 1950.

Get Out the Scrap

From many quarters is coming the appeal that as much iron scrap as can be collected by any individual or firm be gotten together and put back into circulation through regular channels.

The N.P.A. estimates that 36 million tons of iron scrap is needed if the 1951 ingot and castings goal of 110 million tons is to be met.

The government and the steel industry have joined in an effort to get iron scrap back into trade channels. Every water and sewage works man will be doing every one concerned a good turn by putting on a general plant clean-out and get rid of accumulated scrap which is doing nobody any good where it is now laying.

Republic Steel Supports Wastes Research Program

An unrestricted grant of $7,500 by the Republic Steel Corporation will help support research studies of industrial wastes disposal at Ohio State University.

The grant was presented to the University's Development Fund by Earle C. Smith, Cleveland, chief metallurgist for the steel firm, at a recent meeting of industrial, state and university officials on the campus.

The scientific investigations will be conducted at a pilot plant now under construction on the east bank of the Olentangy River.

The Ohio Legislature has authorized the studies and has allocated $100,000 to the state Water Resources Board for the research to be done by the Ohio Engineering Experiment Station.

He who takes himself too seriously fools nobody but himself.

Water Pollution Control
"Standards" and "Objectives"

With particular reference to developments affecting industry in New York State.

by RAYMOND W. HESS,* *Chemical Engr., Nat'l. Aniline Div., Allied Chemical & Dye Corp., Buffalo, N. Y.*

SINCE the ending of World War II continuing accelerated attention has been given to the control of water pollution by agencies of government at international, federal, state and local levels.

At the international level we have as a controlling factor the long existing treaty between the United States and Canada. In this treaty is a proviso that pollution shall not be discharged into the boundary waters which will prove to be injurious to the waters on the other side. In other words, neither the United States nor Canada shall create pollution that is detrimental to the other. An International Joint Commission appointed by the two governments has the function of investigating to determine compliance or contravention of these treaty provisions. This Commission has been working in the direction of stimulating or developing a pollution abatement and control program for boundary waters during the past five years.

At the Federal Level

At the federal level is the Water Pollution Control Division of the U.S. Public Health Service. This agency was created by Public Law 845 of the 80th Congress during 1948. Its chief function seems to be the promotion and stimulation of pollution abatement through cooperative programs, research and advancement of funds for use by the several states. However, it has authority with respect to interstate waters, to act if the states fail to do so. In this connection the country is divided into about a dozen drainage basins.

Another possible federal participation in pollution control is being evolved by President Truman's Water Resources Policy Commission which has recommended a Federal program for conservation of the nation's water resources. In such a program pollution control would be integrated.

Interstate Compacts

Below this for various interstate drainage basins the interstate compacts and agreements are, to a considerable extent, the controlling factors. The eastern part of New York State is involved in the following four of these compacts—The Interstate Commission of the Delaware River Basin (Incodel), The Interstate Sanitation Commission of New York, New Jersey and Connecticut, the New England Interstate Water Pollution Control Commission and the (at present unofficial) Interstate Commission on the Lake Champlain Basin. New York State is also a member of the Ohio River Valley Water Sanitation Compact, the jurisdiction of which includes the south-western part of the state.

At the State Level

At the next level are the individual state controls. Most states have tightened up on their controls and have strengthened their powers by additional legislation since World War II.

During 1946-1949 the Special Pollution Abatement Committee of the New York State Legislature studied the needs for and drafted, in consultation with affected interests, including industry as represented especially by the Walter Pollution Advisory Committee of Associated Industries of New York State, Inc., the Ostertag bill which became Article 6 of the New York State Public Health Law in 1949. This law created a Water Pollution Control Board comprised of the State Commissioners of Health, Conservation, Agriculture and Markets, and Commerce and the Superintendent of the Department of Public Works with the Commissioner of Health serving as chairman. The Board has appointed the President of Associated Industries of New York State, Inc. as an advisory member. This Board, among other things, is assigned the duty of placing all waters of the state into classes having standards of quality related to best usages in each location, after the holding of public hearings. Previous laws will remain in full effect until the state's waters are classified.

A general state-wide Classification-Standards System was drafted by the N.Y. Board's Technical Committee, and was adopted by the Board in October 1950 after much consultation and several meetings followed by public hearings. This system does not relate to any specific waters, but establishes the pattern by means of which all the various waters of the state will be classified individually as rapidly as the board can make the necessary investigations, prepare reports and hold the required public hearings. The committee is comprised of those connected with the five State Departments represented on the Board, the Interstate Sanitation Commission, the U.S. Public Health Service and industry, including the chairman of the Water Pollution Advisory Committee of Associated Industries of New York State, Inc. and a representative of industry at large.

The Board is presently making pollution surveys of the waters of the

This article is based on a discussion before the Western N.Y. Section of the Am. Institute of Chemical Engrs. by Mr. Hess.

The author has had a number of years of experience in dealing with the pollution problem in varied capacities, such as the following. Member of the N.Y. State Water Pollution Control Board's Technical Committee, representing industry; Member Industrial Wastes Committee of the Federation of Sewage and Industrial Wastes Assns.; Chairman Water Pollution Advisory Comm., of Associated Industries of N.Y. State Inc.; Member and Past-Chairman, Water Pollution Abatement Comm. of the Manufacturing Chemists' Association, Inc.

This paper is, therefore, an analysis and comparison of pollution control regulations of N.Y. State and those of the International Joint Boundry Commission, reflecting the viewpoints of an industrial advisor in stream pollution matters.

*Chm'n., Water Pollution Advisory Comm., Assoc. Industries of N.Y. State, Inc., and former Chm'n. Pollution Abatement Comm. Mfgr's. Chemists Asso., Inc.

state, preparatory to classification. Those for the Rondout-Walkill and Chautauqua Lake Regions have been completed and that for the Onondaga Lake region is underway.

At Local Levels

More localized levels of control reside in the County Health Departments; and finally there are the municipal and so-called Sewer Authority controls. The latter agencies have their problems in connection with industrial wastes received into their sewer systems, and may be mandated by law to clean up all forms of pollution. As a case at point, for several years the Buffalo Sewer Authority has spearheaded a pollution abatement program in connection with the Buffalo River.

Defining Water Pollution

The trend is toward defining pollution as the presence of wastes in amounts *only* which make each water unsuitable for its most important usages in the locality. By this process it is true that some of the less important usages for some waters may have to be sacrificed to the *general good*. Some categories from which the most important usages are selected in each locality are: drinking, food processing, fish culture, fish survival, bathing and other forms of recreation, agriculture, navigation, industrial processing, industrial cooling, disposal of sewage and industrial wastes. If the most important usages of a segment of a certain water is deemed to be navigation and industrial cooling the standard of quality may not be suitable for other uses and a source for such other uses must be found elsewhere. Under this definition waste discharges are given attention only when the criteria of quality for the specified use is violated or threatened.

Sometimes this definition is expressed by the Classification-Standards System of N.Y. State, which places each segment of natural waters into well defined categories. Sometimes it is expressed by special consideration to each segment of a given waterway. Since, according to this definition, pollution is a function of the concentration of wastes, diversion of water from a stream before receiving wastes, as well as discharge of larger amounts of wastes without diversion, could result in pollution. A big problem in this definition is the establishment of *criteria of quality* which are soundly related to uses.

Criteria of Water Quality According to Usage

Criteria of quality in relation to specific usages usually employed are:

1—Characteristics such as biochemical oxygen demand (BOD), acidity, alkalinity, p.H., color, temperature and chlorine demands.

2—Broadly classified substances such as suspended solids, settleable solids, dissolved solids, floating solids, sludge deposits and oils.

3—Specific substances such as dissolved oxygen (DO), phenols, and compounds of ammonia, cyanide; copper, zinc, lead, cadmium, chromium and iron.

4—Coliform organisms and other biological characteristics.

Under the usage definition of pollution the allowed limits for these characteristics and substances vary according to specified usages of waters which receive the wastes. Some accepted relationships of these criteria to usages will be exemplified by the following discussion of the New York State Water Classification-Standards System.

The N. Y. State Water Classification Standards System

Under this system there are according to "best usage" seven classes for fresh surface waters, four classes for tidal salt waters and two classes for underground waters. Each class has specifications of quality of the nature of those listed above. The system implies that these classes may be further divided into what would be in reality subclasses, although this terminology is not used. For example, four of the classes for fresh surface waters specify a dissolved oxygen content of either 5 or 4 parts per million, depending on whether one of the best usages is for trout, or for other types of fish.

An important condition for the New York State Classification-Standards System is that when waters are classified the specifications may be qualified for any class, if the standards of quality of waters into which they flow are violated by mixing.

An important rule for the system is that samples of waters for testing the resultant quality of receiving waters will be taken only "after opportunity for reasonable dilution and mixture with the wastes discharged thereto."

The plan for controlling wastes discharges to insure conformity with the standards to be established for specific waters has not yet been disclosed.

Fresh Surface Waters

At this point attention is called to the author's tabulation of "Usages and Their Specifications of Each Class of Fresh Surface Waters in New York State"—a roughly condensed tabulation. It must be borne in mind that this tabulation and any remarks on it is an attempt at a simplified interpretation of an introductory nature by the author. A full and accurate understanding of the "System" can be gained only by a study of the official document. A full interpretation must rest with the N.Y. State Water Pollution Control Board; or, in the last analysis, with the courts.

A Roughly Condensed Tabulation of Usage and Their Specifications for Each Class of Fresh Surface Waters in N.Y. State

CLASS	AA	A	B	C	D	E	F
Best Usage	Drink. & Food prep. after disinfec. Fishing	Drink. & Food prep. after compl. treat. Fishing & other	Bathing, fishing & other	Fishing & other	Fish Surviv. Industrial, Agricul., other	Navigation	Waste Disp.
Float. & sett. solids; oil; sludge dep.	None	None visible or deleterious	Same as A	Same as A	Same as A	None which interfere with navigation or cause pub. nuisance	None which cause public nuisance
Phenols	None	Max. 5 ppb					
Other taste & Odor prod. sub.	None	Max. threshold odor 8 above nat. T&O.				None which cause pub. nuisance	Same as E
Sewage & Wastes	None not disinfec.	Same as AA	Same as AA				
pH	6.5-8.5	Same as AA	Same as AA	Same as AA	6.0-9.5	Min. 5.0	
Dissolved oxygen	Trout waters 5, others 4 ppm.	Same as AA	Same as AA	Same as AA	Min. 3 ppm	Sufficient to prevent odor nuisance	Same as E
Toxic, deleterious colored or other wastes, or heat.	None injurious to best usage of Class AA	None injurious to best usage of Class A	None injurious to best usage of Class B	None injurious to best usage of Class C	None injurious to best usage of Class D		
Other specifications	Footnotes 1 & 2	Footnotes 1 & 2	Footnote 2	Footnote 2	Footnote 2		

1. In all other respects, after approved treatments at the water plant, the U.S. "Public Health Drinking Water Standards" will be used as the guide for safety and suitability for drinking and food preparation.
2. No limits for ammonia or ammonium compounds, cyanide, ferro—or ferricyanide, copper, zinc or cadmium are specified but possible limits under certain conditions are suggested.

Features of Tabulation

The following features of this tabulation in relationship to wastes are called to attention.

1—Disposal of wastes is one recognized best usage for waters of New York State.

2—Any class of waters can be used for purposes listed in all lower classes provided the specifications of that class are not violated. For example it is likely that the Niagara River, for which it is not practical to exclude usages given in classes B to F, will be placed in Class A.

3—It will be noted that no numerical limits are given for a large proportion of the specifications, leaving the limits to the judgment (present and future) of the Water Pollution Control Board, subject ultimately if need be by support of the courts, on the basis of specific considerations of a practical nature involved in each case.

4—The limits for phenolic compounds are related to water use for drinking and food preparation, rather than effects on fish life. The limit in Class A is higher than in Class AA because of more complete treatment at the water plant which removes phenolic substances.

5—The limit for dissolved oxygen in Class D is related to fish survival rather than to industrial or agricultural usages.

6—The system indicates toxic, deleterious, colored or other wastes, or heated liquids may be limited in Classes A-D by best usages other than those specified.

Tidal Salt Waters and Underground Waters

In rough comparison of the four classes of Tidal Salt Waters with the seven classes of Fresh Surface Waters, the following omissions and additions have been made.

Best usages given specifically omit drinking, food preparation, industrial cooling and processing, and agriculture. Shell fishing for market purposes is added.

The specifications omitted are phenolic compounds and other taste and odor producing substances. They add limits for garbage, cinders, ashes, oils, sludge or other refuse in any waters of the Marine District as defined by the State Conservation Law, and for organisms of the coliform group.

In rough comparison of two classes of underground waters with the seven classes of fresh surface waters, best usages omit fish life, bathing and navigation, add none, and the specifications are altered accordingly.

A Comparison of Objectives I. J. C. and N. Y. State

Like the New York State Classification-Standards System the objectives of the International Joint Commission recognize the principle of initial dilution in judging the quality of waters. The former calls its criteria of water quality "Standards" while the latter calls them "Objectives." The state standards are *limited to receiving waters* while the international objectives *include both effluent and receiving waters.*

Assuming that the Niagara River would be placed in Class A in the state system, the following comparison of the State's "Standards" with I.J.C.'s "Objectives" is made:

ored or other wastes, or heated liquids in receiving waters. It is merely stated that these substances must not be present in amounts deleterious to uses specified.

Obviously, the only difference between specific criteria for quality of receiving waters is the slightly lower limit for pH but it is doubtful if there is a probability of this going below the international objective after initial dilution because of the enormous quantity of natural alkalinity.

The international numerical objectives for effluents are for phenolics, 20 ppb.; pH, 5.5 to 10.6; iron, 17 ppm. maximum; and for oils 15 ppm. maximum, or not more than enough to create more than a faint iridescence, while New York State gives no specific standards for effluent.

Thus it is seen that the way is open for both agencies to be in complete accord on all criteria of quality for both effluent and receiving waters, excepting the minor difference in pH for receiving waters. By not having specific values for certain criteria, one by adopting the specific values of the other, and by both agreeing on those criteria for which numerical values are not given in either case, both can be in complete accord. In event that one agency should not agree with the specific criteria of the other, the latter could be altered without legislative action. Even though they come to no agreement on some of the *specific* values, it might be held that they are not really in disagreement since the

	N. Y. Standards Class "A" Wtrs.	Objectives I. J. C.
Phenolics (ppb.)	Max. 5; No avg.	Max. 5; Avg. 2
pH	6.5-8.5	6.7-8.5
Iron (ppm.)	not specfd.	Max. 0.3
Max. coliform MPN median value per 100 ml. at any point.	not specfd.	2,400
Max. threshold odor No.	8.0 above natural T&O	8.0 above natural T&O
Dissolved Oxygen (ppm.)	4.0-5.0	not specfd.

Neither gives numerical limits for floating solids, settleable solids, oils, sludge deposits, toxic, deleterious colcriteria of one are called "Standards" while those of the other are called "Objectives."

Why High Nitrates in Minnesota Well Waters?

In our August issue a question was raised (p. 92A) as to why such high nitrate content was found in wells located in the southwest corner of Minnesota.

An explanation comes from F. L. Woodward, Chief of Minnesota's Environmental Sanitation Section, to the effect that the extremely high nitrate values are found in the relatively shallow wells in the southwestern corner of the state, where the upper layers of soil are glacial drift. The shallow rural wells terminate in the drift which is rich in nitrates. The same soil conditions are also found in the adjacent areas of South Dakota and Iowa. But—how did the nitrates get in the glacial drift?

Laboratory Design

The National Research Council Report on Design, Construction and Equipment of Laboratories has been edited by H. S. Coleman, Asst. Dir., Mellon Inst. and published by Reinhold.

According to the preface, the "book is intended to be especially helpful to laboratory directors and science teachers and to their architects and engineers, not only in planning and building but also in remodeling or enlarging their quarters. Its contents are concerned solely with where scientific work can be well done. . . ."

Part I, dealing with Materials, Facilities, Services and Equipment is of particular interest to sanitary engineers and consultants. Part II deals with Teaching Laboratories, Part III with Industrial Laboratories, and Part IV with Concise Descriptions of Some Modern Laboratories.

"Laboratory Design" contains 389 pages (9x12) and is liberally illustrated. It may be obtained for $12 per copy from Reinhold Publishing Corp., 330 W. 42nd St., New York 18, N.Y.

Rates and Rate Structures for Water and Sewage Works

A review of a joint report on fundamentals in rate making and rate structures published in the 1951 Spring Number of the Ohio State Law Journal and reprinted for distribution to participating groups

THE subject report is the result of group discussion and deliberations at special meetings of a joint committee held during the past three years. The project originated out of interprofessional cooperation of lawyers representing the Section of Municipal Law of the American Bar Association and engineers representing the American Society of Civil Engineers pointed up by a paper presented by Samuel A. Greeley before the Municipal Law Section at the 1947 meeting of the American Bar Association held in Cleveland, Ohio. It was felt that a significant forward step could be taken to clarify confused thinking if the engineering, financial and legal professions could agree on some basic principles in rate making. While the Joint Report, now published, does not speak for any particular one of the groups represented nor for any individual representative, it does present the consensus of the committee as a whole on the basic principles involved.

The report as published consists of 126 pages of solid material divided into ten chapters with a Foreword outlining the origin of the study, and the names of those participating.

Chapter 1 is a short introduction and statement of the problem. It presents logical methods of approach to a solution of the problem of establishing a fair rate structure for financing the construction, administration, operation and maintenance of water and sewage works. The premise is stated simply in the following paragraph:

> "The needed total annual revenue of a water or sewage works shall be contributed by users and non-users (or by users and properties) for whose use, need and benefit the facilities of the works are provided approximately in proportion to the cost of providing the use and the benefits of the works."

Chapter 2 is in two parts describing (1) the elements and functions of a water works system and (2) the elements and functions of sewage works. Having in mind the general application of the report this short descriptive chapter is well placed for reader comprehension of the vital importance of these services. The description is concise and simple with diagrammatic illustrations of water works facilities and a sewage works system.

The committee recognized the differences that enter into any discussion of rates applicable to publicly and privately owned utilities. Chapter 3 therefore is devoted to comparisons of the effect of various factors under the two types of ownership. Comparisons in this chapter cover four phases of the problem.

(1) Methods of Financing
(2) Sources of Revenue
(3) Revenue Requirements
(4) Governmental Regulation

The report then covers separately, in Chapters 4 and 5 respectively, the Financing of Publicly-Owned Water and Sewer Utilities and the Financing of Privately-Owned Facilities. There is much meat in Chapter 4 and the careful reader will want to refer particularly to the footnotes in this chapter as they apply to the text material. Throughout the report the language has been carefully weighed and statements carefully checked and well documented. Chapter 4 reaffirms the basic understanding upon which considerations of rate structures and financing are predicated, namely that:

(a) Each property, occupied or not, receives benefits, either actual or latent, from the existence of water and sewage works in the community.
(b) Each property is further benefited by the existence of water mains and sewers in the streets adjacent to the property.
(c) Each person, whether a user or non-user, is benefited by the existence of water and sewage works in the community, through improved public health, fire protection or drainage, and through civic improvement, industrial property and property development.
(d) Each person who is a user is benefited to a greater degree than the non-user.

After discussion of these general considerations specific attention is given to the application of general obligation bonds, special assessments, and revenue bonds. More space is devoted to revenue bonds than to the older methods of financing water and sewage facilities. The documentation by the footnotes under the section on "Revenue Bonds" is of particular interest and importance because of the definite trend toward a wider use of revenue issues. The sections which follow on Diversions of Funds; Rates and Charges, Authority Financing; Sewer and Water Districts have direct reference to revenue financing and the final section of Chapter 4 discusses combinations of financing methods as applicable to each of the three major elements of cost, namely, (a) construction or replacement of major structures, (b) construction or replacement of local structures, and (c) operation and maintenance.

A concise description of the financing of privately-owned water and sewage facilities is given in Chapter 5.

Chapter 6, although brief, is the result of condensing considerable material and resolving divergent views to present illustrative examples as a guide to the determination of annual revenue requirements.

Having determined what the annual revenue requirements should be there follows an informative chapter on Present Practices in Raising Total Anual Revenue, with water works and sewage works covered under separate sections. Illustrations are then presented of water and sewage works combined under a common management.

Perhaps the most difficult chapter for the careful reader will be Chapter 8. The meat in this bountiful chapter is the result of thoroughgoing examination by the subcommittees separately and by the individual members of the entire joint committee. It is at this point that careful deliberation is necessary to bring about a meeting of the minds as to the fundamental considerations. Careful definitions of words and phrases used in a technical sense are set forth in the chapter. In spite of many individual differences of opinion there has been brought together in this one chapter many loose ends and a common understanding established on many highly controversial phases of a complete rate structure. The question of allocation of costs to public fire protection, for example, is not susceptible to a single answer without modification, but the

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Ed. Note: For this splendid review we are indebted to Wm. F. Tempest, Secy., Am. Bar Association, and a member of the Joint Committee.

report indicates that on this and other difficult areas of disagreement individual concepts could be reconciled to a point that was in focus for the group as a whole. In this way progress was made toward recommendations that could be approved by group action for publication. It would be impossible to cover this chapter adequately in a review nor is it possible for the reader to get the import or the full measure of benefit from this chapter by casual reading. This is the chapter for which the previous chapters contributed the foundation. It should be read with full knowledge of the careful deliberations and the serious consideration and discussion of every recommendation made.

No rate structure however carefully drawn is self operating. There must also be established methods of enforcing payment of water and sewage charges. Chapter 9 covers this important phase to make the report complete. Although it is stated in the introduction to this chapter that exhaustive documentation will not be attempted, there are copious footnotes that provide citations and valuable references not readily available elsewhere in a single treatise. Those charged with the responsibilities of management of water and sewage facilities will find the material and references in this chapter especially helpful.

The tenth and final chapter is a summary in the nature of a review. For those who like to turn to the last chapter of a book first, the summary should lead to a careful examination of the entire report. It directs attention to the high-lights of each of the nine chapters; and, in so doing, illustrates the point and purpose of this experiment in interprofessional cooperation and common effort on a high level of skill, integrity and good common sense. Copies of the report are being made available at cost of production and distribution* from the Ohio State Law Journal, Ohio State University, Columbus, Ohio.

*Presently estimated at not more than 75 cents nor less than 50 cents per copy for this highly valuable report.—Ed.

"Pipeline to the Clouds"

New "G-E" Film Spots Importance of Water Supply Planning

The General Electric Co. has announced a visual program designed to make Americans aware of the growing threat of water shortages and to enlist support behind community water works project planning and financing.

Latest in the company's "More Power to America" series, the program features an outstanding 25-minute, full-color, sound motion picture, "Pipeline to the Clouds."

Scene from "Pipeline to the Clouds" designed to impress the public that water supply shortages can—and will happen if adequate planning is neglected.

Dramatizing the importance of water to the individual and his community, the 16 mm. film outlines the need for immediate action to combat potential shortages and to assure safe, adequate supplies. The picture was produced by the Raphael G. Wolff Studios of Hollywood with the technical assistance of the American Water Works Association and the United States Public Health Service.

Other important elements of the program are a 40-page manual, "Good Water—And Plenty Of It," and a four-page audience hand-out entitled, "Wonders of Water."

The Manual, prepared with the assistance of the A.W.W.A., is aimed at helping water works men, other municipal officials, and civic leaders in their program of showing their communities the urgency of the local water supply situation.

The pamphlet, "Wonders of Water," presents startling and little known facts about water supply, and emphasizes the relationship of the individual citizen to water works improvements.

Program kits, containing a print of the film, five copies of the manual and 200 pamphlets, are available at the reproduction cost of $170 to industrial and civic organizations wishing to conduct campaigns to improve local water supply conditions or secure additional sources of supply in advance of the time of dire need.

The new film with the captivating title "Pipeline to The Clouds" has been shown before several water works association meetings where it has created much favorable comment. It is a companion film to "G.E.'s" earlier "Clean Streams" which has been widely used in promoting stream pollution abatement in America.

Bacterial Quality Objectives for the Ohio River

The final report on "BACTERIAL QUALITY OBJECTIVES FOR THE OHIO RIVER," which were adopted by the Ohio River Valley Water Sanitation Commission, has now been published.

The report sets forth the objectives for both water supply and recreational uses, the manner in which the objectives are to be interpreted, and the background for their validity. In a large measure this report is the work of Harold W. Streeter, U.S.P.H.S. (ret.) who now serves as Consultant to the Commission.

The booklet containing 26 pages devotes one section to a summary of the objectives, a second to interpretation and application, and a third to background and validation. Among the topics covered are water supply objectives, recreational water objectives, state and regional standards, and efficiency of filtration plants.

This report will be of interest to sanitary engineers and water supply and sewage plant technical personnel, interested in stream pollution. Copies of the report may be obtained from E. J. Cleary, Exec. Dir. and Ch. Engr., Ohio River Valley Water Sanitation Commission, 414 Walnut St., Cincinnati 2, Ohio.

(Cartoon by courtesy of Nat'l. Clay Pipe Mfgrs. Assn., Inc.)

Good morning my dear lady: Could these very attractive flower-urns have once been sewer pipes? Strangely enough, when we finished laying the new sewer down your street last week we ended up just two lengths of pipe short.

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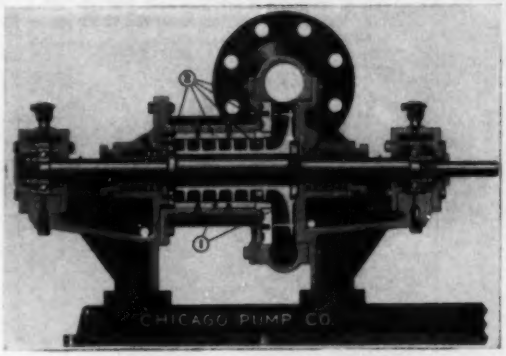

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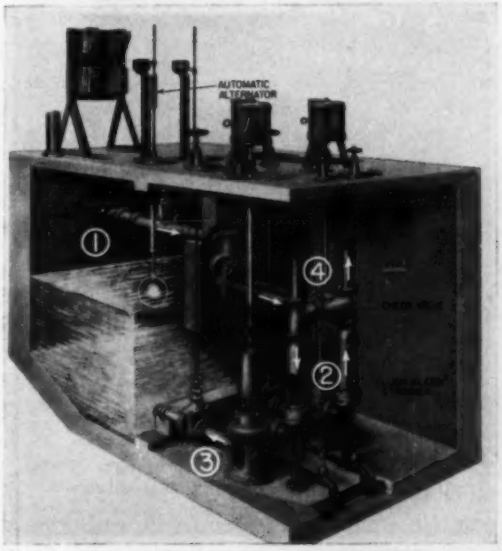
PUMPING

3. Strained sewage is pumped from wet well.
2. Coarse matter is backwashed from strainer.
4. Special check valve closes; sewage and coarse matter are pumped to sewers.



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STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233)

Of *Water and Sewage Works*, published monthly at Mount Morris (Ogle County), Illinois, for October 1, 1951.

1. The names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Edward S. Gillette, 22 W. Maple St., Chicago 10, Ill.

Editor, L. H. Enslow, 155 East 44th St., New York 17, N.Y.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

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4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

EDWARD S. GILLETTE,
Publisher.

Sworn to and subscribed before me this 1st day of October, 1951.

(Seal) CLARE MEHL.

(My commission expires Dec. 18, 1952.)

Meetings Scheduled

Nov. 6-7—Providence, R.I. *(Sheraton Biltmore Hotel)*
NEW ENGLAND SEWAGE WORKS ASSOCIATION. Sec'y, Walter E. Merrill, 511-A State House, Boston, Mass.

Nov. 7-9—Roanoke, Va. *(Hotel Roanoke)*
VIRGINIA SECTION A.W.W.A. Sec'y, W. H. Shewbridge, 708 State Office Bldg., Richmond 19, Va.

Nov. 12-14—Winston-Salem, N.C. *(Robert E. Lee Hotel)*
NORTH CAROLINA SECTION A.W.W.A. and NORTH CAROLINA SEWAGE & INDUSTRIAL WASTES ASSN. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N.C.

Nov. 15—Boston, Mass. *(Hotel Statler)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly meeting). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Dec. 3-7—Stillwater, Okla. *(Oklahoma A. & M.)*
OKLAHOMA WATER, SEWAGE & INDUSTRIAL WASTES CONFERENCE SHORT SCHOOL. Director, Foster S. Burba, Eng. Bldg., Okla. A. & M. College, Sitillwater, Okla.

Dec. 10-14—Stillwater, Okla. *(Oklahoma A. & M.)*
OKLAHOMA WATER, SEWAGE & INDUSTRIAL WASTE CONFERENCE. Sec'y, H. J. Darcey, State Dept. of Health, Oklahoma City 5, Okla.

Dec. 12—Hallowell, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, Winthrop Water District, Winthrop, Me.

Dec. 20—Boston, Mass. *(Hotel Statler)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly meeting). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Jan. 15, 1952—New York, N.Y. *(Hotel Park Sheraton)*
NEW YORK SECTION A.W.W.A. (Winter Luncheon Meeting) Sec'y, R. K. Blanchard, 50 West 50th Street, New York, N.Y.

Jan. 17-18—New York, N.Y. *(Statler Hotel)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Ralph C. Sweeney, State Board of Health, 21 No. Broadway, White Plains, N.Y.

Feb. 13-15—Indianapolis, Ind. *(Lincoln Hotel)*
INDIANA SECTION A.W.W.A. Sec'y, Geo. G. Fassnacht, 1330 W. Michigan St., Indianapolis 7, Ind.

Mar. 9-13—College Station, Texas *(Texas A. & M. College)*
TEXAS WATER & SEWAGE WORKS ASSOCIATION. Sec'y, V. M. Ehlers, 501 West 33rd St., Austin, Texas.

Mar. 24-26—Augusta, Ga. *(Bon Air Hotel)*
SOUTHEASTERN SECTION A.W.W.A. Sec'y, T. A. Kolb, State Board of Health, Wade Hampton Building, Columbia, S.C.

Mar. 26-28—Chicago, Ill. *(Hotel not decided)*
ILLINOIS SECTION A.W.W.A. Sec'y, J. L. Hart, 122 So. Michigan Ave., Chicago 3, Ill.

Apr. 3-5—Mesa, Arizona *(Maricopa Inn)*
ARIZONA SECTION A.W.W.A. Sec'y, H. S. Jordan, State Dept. of Health, Phoenix, Ariz.

Apr. 7-9—Fayetteville, Ark. *(University of Arkansas, Eng. Bldg.)*
ARKANSAS WATER & SEWAGE CONFERENCE. Dr. Harrison Hale, Southern State College, Magnolia, Ark.

Apr. 11-12—Billings, Mont. *(Northern Hotel)*
MONTANA SECTION A.W.W.A. Sec'y, A. W. Clarkson, State Board of Health, Helena, Mont.

Apr. 16-18—Syracuse, N.Y. *(Hotel Syracuse)*
NEW YORK SECTION A.W.W.A. (Spring Meeting). Sec'y, R. K. Blanchard, 50 West 50th St., New York, N.Y.

Apr. 17-18—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION A.W.W.A. Sec'y, E. Bruce Meier, University of Nebraska, Lincoln, Neb.

Apr. 22-26—Spokane, Wash. *(Hotel not decided)*—tentative
PACIFIC NORTHWEST SECTION A.W.W.A. Sec'y, O. P. Newman, Boisie Water Corp., Boisie, Idaho.

May 4-9—Kansas City, Mo. *(Reservation announcement by Dec. 1st)*
AMERICAN WATER WORKS ASSOCIATION (Annual Convention) Exec.-Sec'y, Harry E. Jordan, 521 Fifth Avenue, New York 17, N.Y.

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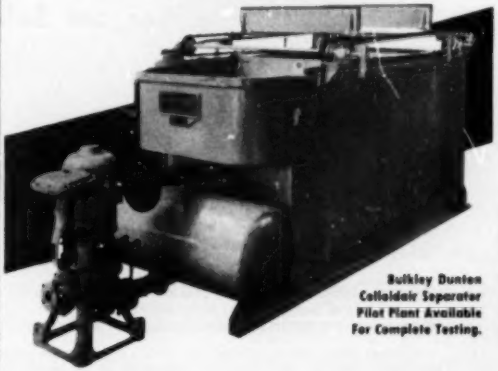

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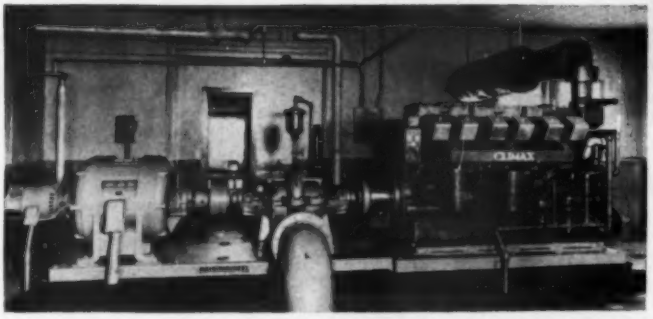

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LOW COST MAINTENANCE

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Climax Engines are recommended for direct connection to individual pumps or through disconnect, free wheeling or automatic clutch couplings to motor driven pumps, where the motor is used for normal operation and the engine for emergencies.

For water works service Climax Engines are the choice because of their low upkeep expense, extra quick starting and sufficient surplus capacity to supply power for an indefinite period of time.

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Here's That Man Again—And the first thing I want to do is to thank all of you nice people who took the time to drop me a line wishing me well in my new venture as an independent consultant and free lance writer. I sincerely hope that you will continue to write and to send me stories for future columns.

* * *

Before I am expelled from membership in the Wisconsin AWWA Beanie Club, I must apologize for stating in the September Column that Art Kuranz is from Kenosha, when everyone in the whole wide world knows very well that he is the famous Waukesha Water Boy.

* * *

And now for some mail bag—F. W. Kittrell, who left TVA for AEC, at Oak Ridge, and who in the days to come will, no doubt, be known as "Isotopes Kit," has an expert speller in his family to help him with all of those radioactive terms. Son John won a trip to Washington to compete in the finals of the National Spelling Bee. John didn't win first place, but—during one of the intermissions he tore his trousers "in a most embarrassing place" and his performance thereafter became the outstanding feature of the meet.

* * *

Right after my June Column, I had a letter from E. L. (Blue Print Now) Filby of Black and Veatch in Kansas City. E. L. said that after that column appeared he had a letter from Prof. (Prince Charlie) Walker of Cornell Univ. Incidentally, Prof. Walker has come out of retirement again to teach sanitary engineering since Prof. H. M. (Pinky) Gifft lost some of his staff to the services.

E. L. went on—"I note that you are writing up Earnest Boyce" (See Aug. W & S W, p. 87 A) "and as an old member of Bi-Co-Li, I could spin many a yarn about the staid profes-

(*Continued on page* 86A)

removed under pressure

This pipe section was cut, under pressure, from a 48" main without shut-down or other interruption to service. The operation was performed in the course of inserting a gate valve in a 48" cast iron main, in the distribution system of the Water Bureau, City of Philadelphia, Pa.

Gate valves can be inserted under *pressure* by SMITH in cast iron, asbestos–cement or steel water mains, sizes 4" and larger, without shutting off service or dewatering the line.

30

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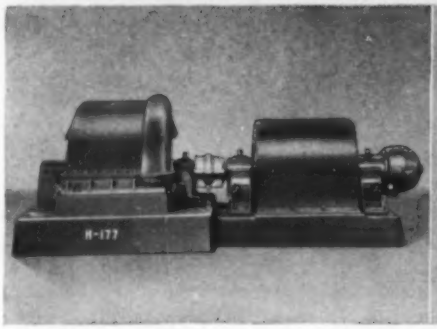

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R-C engineers will gladly help you select the right blowers with the V-P-L needed to provide reliability and economy.

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R-C Rotary Positive Blower in sewage treatment service in a small midwestern city. Capacity 600 cfm.

ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

(*Continued from page* 84A)

sor. That gang of yesteryear meetings of the A.P.H.A. sure had a fondness for Gorgonzola cheese, rye bread, square and round crackers, with a chaser of Bacardi and ginger-ale. I certainly must be getting old, when all I can do is recall so-called 'good old days'."

* * *

Recently ran across an old letter from Fred Van Kirk of Chicago Pump Co. When I met Fred a few years back it was as a fraternity brother at Purdue and he was one of Don Bloodgood's promising senior sanitary engineers. Since joining Chicago Pump, Fred has been many places, the interior of British Columbia, the southwest, Minnesota, and at Jasper, Ind. where the first all city garbage Disposall program was installed.

* * *

I didn't get to the Chicago meeting of the Illinois Section this past spring, but I did receive this photograph of the big wheels of that section—Came from Lindy (Omega) Harper.

I recognize all but one—from left to right: H. E. (Boone) Hudson, Ch. Engr. of the Ill. State Water Survey at Champaign and a onetime student of mine; Oscar Gullans, Dir. of Chi. Filt. Labs.; W. R. Gelston, Supt. at Quincy; Ed. (Storyteller) Alt of Chicago Bridge & Iron; J. C. (Cliff) Moomau, Mgr. at Sterling; (???); and J. Leslie (All American) Hart of U.S. Pipe & Fdry. at Chicago.

* * *

The w.k.—I might even say, famous—E. A. (Mr. Nuchar) Sigworth took dictaphone in hand on Aug. 15 and a day or so later, I received the following:

"I have read your comments in your August Column regarding the City Water Dept. at Atlanta using dry ice to freeze a water line. I was particularly interested in your wondering whether the idea was derived from an article in *Water & Sewage Works*. . . . I should like to enlighten you on the subject.

"During the early years of World War II, Paul Weir asked me to appear on the program of the Georgia Water Works School to talk on gad-

(*Continued on page* 88A)

4 reasons why CONCRETE PIPE gets the call for sewers

FROM giant trunk line installations to small diameter sanitary sewers concrete pipe is the choice of leading sanitary engineers from coast to coast when specifying pipe for sewers. There are four sound engineering reasons for this nation-wide preference:

1. AMPLE STRENGTH. Concrete pipe is so rugged it is able to resist severe impact, sustain heavy overburdens and withstand the wearing action of severe climatic or soil conditions.

2. OUTSTANDING DURABILITY. When you specify concrete pipe you assure long years of trouble-free operation. Many cities have had over a century of service from concrete pipe sewers.

3. MAXIMUM HYDRAULIC CAPACITY. The smooth interior walls and clean, even joints of concrete pipe resist abrasion from suspended matter and provide maximum carrying capacity.

4. UTMOST SAFETY. Concrete pipe's uniformly dense structure and tight joints assure minimum leakage and infiltration, thus helping to reduce contamination along the line and the overloading of sewage treatment plants.

Engineers and taxpayers also prefer concrete pipe sewers for their economy. They are moderate in first cost and serve far longer with little or no maintenance. The result is ***low-annual-cost*** sewer service—the true measure of pipe line economy.

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(*Continued from page 86A*)

gets, etc. . . . In my talk I mentioned (and it was not exactly new at that time) the use of dry ice as a means of freezing pipe lines for their repair. Later we put a brief note on the idea on page 14 of the May 1945 issue of Nuchar's 'Taste and Odor Control Journal' . . ." "Siggie" then proceeded to quote from the T & O Jour.

I was referring to John Ford's article on the same subject for *Water & Sewage Works* (See W & S W, Nov. 1947, p. 413 and April 1948, p. R-124). Anyone else written on this subject????

Some months ago, Dr. H. Heukelekian, Prof. of San. Chem. at Rutgers supplied me with the following letter. I think it's a pertinent commentary at this season of the year.

"Dear Doctor H.—I am writing this because I think higher technical education is falling down on the job. Nobody ever told me that science in action was like this.

"I am at this charming place to run some tests. The work has to do with the characteristics of sludge produced in a softening operation and hence requires a certain amount of gravimetric analysis.

"I cast my experienced eye about the laboratory furnished me in the plant, looking for the chainomatic balance complete with magnetic damper and built in hot and cold running data. I found, on a high dusty shelf, a decrepit apothecary's scale. My scientific ardor somewhat dampened, I proceeded to set it up. One leveling screw is missing, but a newspaper and a book of matches serves nicely to prop the thing up in some semblance of a horizontal plane.

" 'Analytical weights?' I asked. 'Of course!' and I was presented with a cigar box containing one complete set of gram weights with only the five and the head of the ten missing. 'Fractional weights?' 'Naturally!' A mayonnaise jar was placed before me. It contained a motley assortment of grains, drachma, scruples, and an unidentified coin resembling the Russian kopeck. Fifteen point something grains equals one gram. . . . I discarded the drachma, scruples, and the kopeck.

"Somewhat hesitatingly, I asked for drying dishes. With a scornful reply ringing in my ears, I headed for the local scientific supply house (you'd know it as the five and dime). A muffin tin and some skillful surgery with tin snips and I had six imitation platinum dishes.

"Brushing aside a vision of a modern laboratory, I set about my task. It is really quite simple, making weighings on an antiquated, quivering balance with a combination of corroded metric and medieval weights.

"I could go on: There's a stop watch I must use for sludge settling tests—a remarkable product of horology. It runs a minute in 49 seconds flat. I must make a quick decision; either change the mechanics of the solar system, buy an egg timer at the 5 & 10, or apply a factor. Oh yes, a Coca Cola bottle makes an excellent graduate if you can remember which of the indentations is exactly 159 ml.

"The point I'm trying to make is this: You are pampering and spoiling your students. If a man can't gather enough data for his thesis with nothing more than some old razor blades, half a dozen mason jars, and a bathroom scale, he isn't worth his salt in the field."

Unfortunately, Heukelekian did not supply the name of the correspondent who authored this masterpiece of philosophy. And if you think my praise has any tongue-in-cheek quality, I suggest that you refer to a speech I once made. According to the 20-year Index of *Sew. Wks. Jour.* ($4.50 per

(*Continued on page 90A*)

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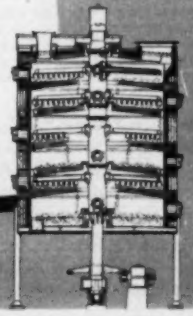


(*Continued from page 88A*)

copy) it was published under the title "Buffalo's Motto" in Vol. 13, p. 611 of S.W.J.

* * *

Anti-Big Head Dept.—Lest we forget—Fortunately for the ego, not all letters received are of the head stretching variety, as witness this one from Fred. C. Downs, U.S. Naval Base, Sewell, N.J., who wrote the editor of *W & S W* as follows: "O.K. on the reports of papers at technical meetings, but not all of those horrible pictures. Also, you can save paper by cutting out the column of Doc Symons. Several of his articles have been of such a nature I have started to cancel my subscription."

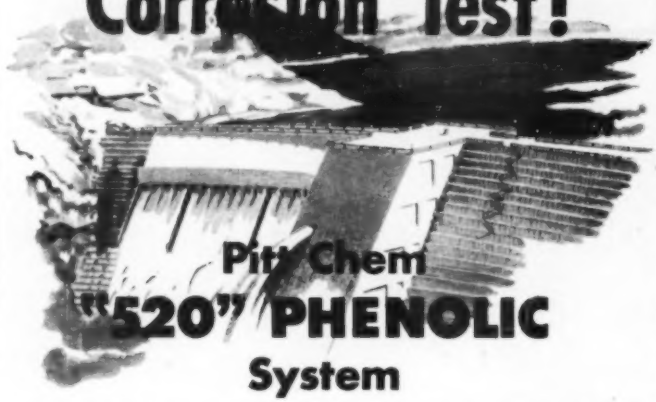
—Hmmmm! As the Brooklyn Dodgers said as they came down that last week's stretch, "You can't win 'em all."

* * *

Next month—Let's go to The N.Y.-N.E. Sew. Wks. Meeting at Springfield, the famous Penn State Meetings at State College, and the equally famous NEWWA meeting at Boston, and perhaps a quick look at Providence, St. Paul and Ithaca, N. Y.

V.T.Y.—Doc.

FIRST in actual Fresh Water Corrosion Test!



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If *you* have a fresh water corrosion problem, in storage tanks, reservoirs, power dams or water transmission systems, we can help you check corrosion, reduce maintenance costs, and lengthen equipment life. ● *Technical information and engineering assistance are yours for the asking.*

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Why Do Bearings Get Hot?*

It is commonly thought that bearings heat because of insufficient lubrication.

To be sure, lack of lubricant is a bad thing, and will invariably cause heat, but that is not *always* the cause of heating.

Let us step back a short distance and take a look at lubricants and lubricating from other angles.

I have known of many instances where lubricants have been purchased because of low price. To the sorrow of the purchaser he soon discovers that his bearings run hot and much money is lost in the shape of power required to overcome the additional friction, plus the cost of the more rapid wear of the machine parts.

High grade oil requires less power, and of course with reduced friction there is less wear and tear on the machinery. Money is saved all around. Mere *quantity* isn't always so important after all.

Clearance is very important. If the clearance in the bearing is either too large or too small the bearing will heat. When clearance is too large there is greater pressure per square inch between the metal parts that make contact or that "almost" make contact, and as a result heating will occur. The shaft that is too small is more liable to cut through the oil film because of this greater pressure. As soon as the film is cut, and we have true metal-to-metal contact, wear becomes very rapid and a "hot box" may result.

On the other hand if clearance is too small the bearing will "bind." If the fit is so close that room for lubricant does not exist it is clear that friction will be great. Then, the greater the friction the greater the heating. With rise in temperature the shaft "swells." Friction may increase until the shaft won't turn at all, regardless of the driving power.

Next comes alignment. If we have several rigid bearings in a row with a shaft through them, and if the bearings are not in perfect alignment, the shaft will surely press more intensely against the edges of the bear-

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

(*Continued on page 92A*)

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THE LARGEST ORGANIZATION OF ITS KIND GIVING SAFE MAINTENANCE AT LOW COST

(*Continued from page* 90A)

ings than elsewhere. The lubricating film will very likely be broken, and heating will result. Even if the bearings are self-aligning there will be greater pressure between the shaft and bearings than where alignment is correct. Whether the bearings are plain, ball, roller, rigid, or self-aligning, and regardless of the lubricant used, they should always be in true alignment.

And then there is dirt. Everybody knows, or should know, that regardless of the kind of oil used, bearings must always be kept clean. The highest priced oil obtainable in the world will not and cannot offset the harm that will be done by dirt. Be sure that the oil applied to any machine is perfectly clean and free from foreign matter, especially grit.

Louisville and Jefferson County Sewage Treatment

Will Cost 10½ Million Dollars.

The total presently estimated cost of the Louisville and Jefferson County Metropolitan Sewer District for a treatment plant, intercepting combined sewers and the District's portion of the four joint-use pumping stations is about 10½ million dollars. The tentative construction program calls for completion of the whole project within six years, if not delayed by the national emergency.

According to L. S. Vance, Technical Adviser to the District, financing of all construction of the Metropolitan Sewer District is from revenues obtained from sewer service charges billed on the basis of water use. Revenue bonds have been and will be issued from time to time in order to anticipate future revenues. No ad valorem taxes are available. Revenues from sewer service charges and construction cost participation deposits will average about 1.6 million dollars per year.

The treatment plant will have a capacity of 95 mgd. with mechanically cleaned bar racks, grit removal chambers, and primary sedimentation of two hour detention. Operation is expected to remove substantially all settleable solids and at least 45 per cent of suspended solids and thereby meet requirements of the Ohio River Valley Water Sanitation Compact.

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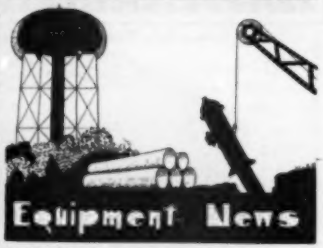
Manufacturers & Equipment News



Self-Priming Motorpump

1101

Ingersoll-Rand Company, Phillipsburg, N.J., has just introduced a new line of Self-Priming Motorpumps These pumps are intended for pumping applications under suction lift where the presence of air or vapor makes it impractical to use the conventional centrifugal pumps.

The new Ingersoll-Rand Self-Priming Motorpump overcomes the usual disadvantages of centrifugal pumps by means of recirculating liquid trapped in the casing. The pump impeller discharges through two passages into a discharge chamber. During priming the upper passage discharges a mixture of vapor and liquid into the discharge chamber. Here the vapor separates from the liquid and passes out the discharge pipe. The remaining liquid reenters the impeller through the lower passage to

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

mix with more vapor drawn in from the suction pipe and is separated from the liquid in the same manner.

When the suction pipe is finally filled with liquid and the pump is primed, flow through the lower passage reverses and both passages act as normal pump discharges. During normal pump operation there are no recirculation losses and thus no need of valves to cut off recirculation. No flap valve is used because the pump casing is so proportioned that sufficient liquid is trapped on shut down to insure priming when the unit is restarted.

The pump is built in sizes from ¼ to 25 hp., with capacities up to 800 gpm. and a head up to 180 feet.

J-M Appoints Phoenix Mgr. Market Surveys

Johns-Manville Corporation, New York, N.Y., has announced the appointment of Edward A. Phoenix to the newly created post of Manager of the Market Surveys Department for the company.

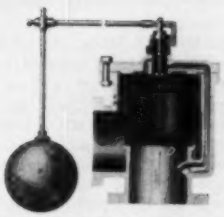
According to W. R. Wilkinson, Vice President for Sales, the primary objective of the new department is to assist in plans for the market development of all Johns-Manville products and to study and analyze markets and methods of distribution, new businesses, new product lines, and other related problems.

Mr. Phoenix, who has been Assistant Manager of the Transite Pipe Department, joined Johns-Manville in 1915 and has held various positions of sales, sales engineering and sales promotion responsibility in the company.

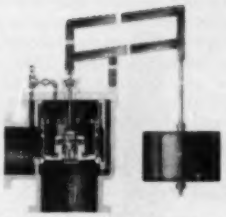
R. B. Reid Named by G-E

General Electric Company, Schenectady, N.Y., has appointed R. B. Reid assistant manager of the advertising and sales promotion department of the Company's Apparatus Marketing Division. The appointment was announced by J. Stanford Smith, department manager.

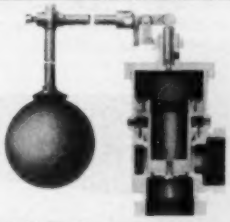
In his new position, Mr. Reid will co-ordinate activities of the department's five advertiisng sections, vis-



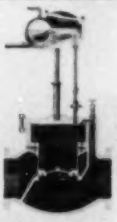
Sizes 3" to 36", cold water, full open or tight closed action, inlet pressure 20 psi-250 psi.



Sizes 2" to 36", cold and hot water, low or high pressure, throttling design.



Sizes ½" to 2", cold water, all bronze snap action, pressure 20 psi to 175 psi.



Sizes 3" to 36", cold or hot water, pressure 20 psi.-250 psi.

For dependable high and low-pressure water level control

Install

GOLDEN-ANDERSON *"Cushioned"*

FLOAT VALVES

Illustrated above are a few of the many Golden-Anderson float operated control valves designed for either cold or hot water, open or closed tank service in reservoirs, tanks, coagulating basins, mixing chambers, etc. These valves may be of either the quick-opening or throttling design with integral or remote pilot control—available in angle or globe body pattern. This special air and water cushioning feature prevents any chatter or bang in operation.

Write for our engineering bulletins. They will interest you!

GOLDEN ANDERSON *Valve Specialty Company*

2075 KEENAN BUILDING ★ PITTSBURGH 22, PA.

ual education section, and the company news bureau at Schenectady.

Manager of industrial advertising for the department from 1943 until his new appointment, Mr. Reid has served General Electric in news, editorial, and advertising capacities for the past 21 years.

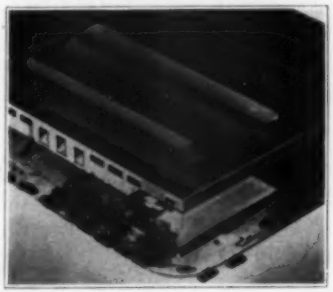
Anti-Rust Paint

1102

The Monroe Company, Inc., Cleveland, Ohio, has announced Rust-Cure, a new labor-saving anti-rust paint which can be applied right over rust without wire-brushing, scraping or sandblasting.

Available in black, aluminum and clear, Rust-Cure is suitable for both interior and exterior use on either old or new metal. Upon application, it is said to penetrate through any existent rust layer and effectively seal the surface against further rust action.

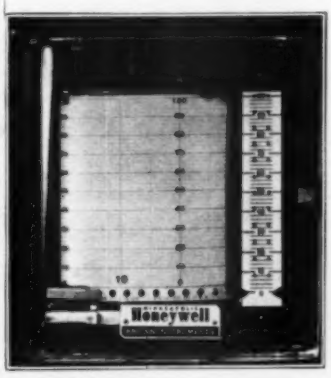
Rust-Cure is compounded for brush application and may be thinned with a special solvent for spray use. Black and aluminum Rust-Cure is for use solely as a finish coat while the clear can be painted over in any desired color. The aluminum is reputed to contain almost twice as much aluminum pigment as ordinary paints and to give an exceptionally brilliant finish coat.



Waste King Moves Into New Plant

Given Manufacturing Company, Los Angeles, Calif., producers of the Waste King Pulverator line of garbage disposers, has announced the completion of their new four acre plant, located at 3301 E. Fruitland, in the industrial district of Los Angeles.

The modern structure is constructed of steel and concrete and includes facilities for production, engineering, research, purchasing, sales and marketing offices, administration and executive offices. A modern display room will be maintained to exhibit both the home and the restaurant Waste King Pulverator models.



Device Made For Better Controls

1103

Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., has developed a new instrument that provides sensitive, instantaneous and accurate control of flow, temperature, pressure, liquid level and other variables.

The device, the Tel-O-Set controller, is described by the company as

WE WELCOME "Shoppers"
"SHOPPING LIST" of FEATURES
GOOD POINTS
Controls and meters chlorine gas in dry, non-corrosive state?
Shows chlorine feed with positive flow rate indicator?
Works the same winter and summer — no chlorine "ice" problems?
Easily adapted to automatic operating systems?
BAD POINTS
Gives off objectionable chlorine odors?
Has troublesome stuffing boxes?
Requires auxiliary injector for stop-start operation?
CHLORINIZER
PRODUCT A
PRODUCT B
YES NO NO
YES NO YES
YES NO YES
YES NO NO
NO YES NO
NO YES YES
NO YES YES
CAPACITY
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If you're buying chlorinating equipment, shop around. We think our CHLORINIZERS are tops . . . but don't take our word for it. Compare Builders Chlorinizers with any other equipment on the market. We like to meet up with hard-headed, fact-seeking buyers, because our chlorine gas feeders are sure to look good on any man's "shopping list".
Builders Chlorinizers are available in three volumetric models — for any chlorination service:
Up to 400 lbs./day . . . Model DVSX . . . Bulletin 840-F2A
Up to 2000 lbs./day . . . Model CVS . . . Bulletin 840-F1
Up to 6000 lbs./day . . . Model HCVS . . . Bulletin 840-G27
For Bulletins, address Builders-Providence, Inc. (Division of Builders Iron Foundry), 350 Harris Ave., Providence 1, R. I.
BUILDERS PROVIDENCE
Instruments

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

the latest component in a series of new devices designed to improve process control. The other components of the group are the differential converter, Tel-O-Set indicator and Tel-O-Set recorder.

The new model is made in two types, one with fixed proportional band, the other with adjustable proportional band. The units are constructed of a number of coded, interchangeable sections separated by diaphragms. Except for manual adjustments of reset on the band unit, the Tel-O-Set controllers operate wholly in response to pneumatic signals.

Buffalo Meter Appoints Duus Factory Manager

Buffalo Meter Company, Buffalo, N. Y., has announced the appointment of Mr. Jens Duus as factory manager following the resignation of Mr. Walter Boals, former factory manager, due to ill health.

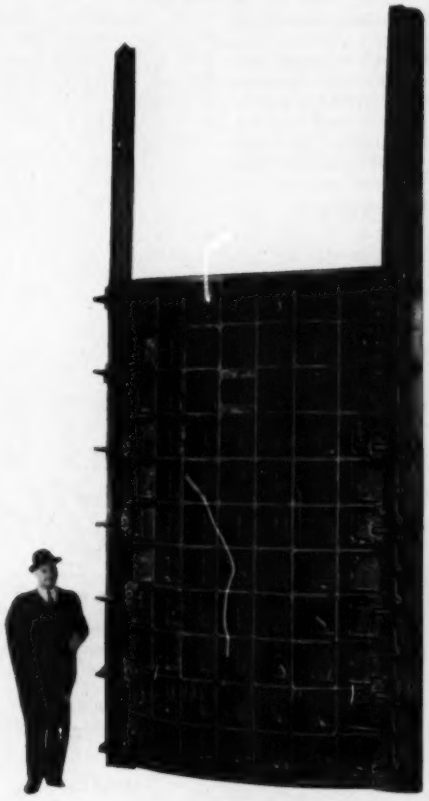
Mr. Duus, connected with water meter manufacturers for over a half-century, was factory manager of the Phoenix Meter Co., from 1925 to 1941, at which time it was bought out by Rockwell Manufacturing Co. Then he went to Brooklyn as factory superintendent of Rockwell's National Meter Division. After the manufacture of Arctic and Tropic meters was moved from Pittsburgh to the National plant, he continued as plant superintendent of the combined manufacturing unit, until his resignation earlier this year.

Sanitary Bell & Spigot Joint Packing

1104

Sackner Products, Inc., Grand Rapids, Mich., has developed a flexible, sanitary packing for bell and spigot joints.

According to the company, authoritative tests have shown that Pakmaster will not support bacterial growth when immersed in sterile water. More malleable than other sanitary packing material, Pakmaster is designed with natural high compressability and packs down with fewer



FILER & STOWELL SLUICE GATES

are built to stand long trouble free service. Amply proportioned for all stresses of shipment, erection and operation. They may be obtained with manual, hydraulic cylinder or motor operating controls.

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CARSON CLAMPS
With Pearlitic C.I. Bolts for Cast Iron Pipe and Fittings.
Write for Prices.
H. Y. CARSON
1221 PINSON ST. BIRMINGHAM, ALA.

strokes of the yarning iron, and will not pull loose because there are no heavy, open loops to snag the yarning iron.

A lightweight, high strength, sanitary binding medium holds the crepe tissue body to uniform diameter, making it easier to handle and pack because the greater portion of its weight is in the body and not in the casing.

Link-Belt Elects Becherer

Link-Belt Company, Chicago, Ill., has announced the election of Mr. Robert C. Becherer as Executive Vice-President with headquarters at the company's Executive Offices in Chicago.

Mr. Becherer was elected vice-president last March. He joined Link-Belt in 1923 upon graduation from Purdue University in chemical engineering and has been general manager of the company's Ewart plant in Indianapolis since 1947.

Mr. Richard E. Whinrey, asst. general manager of the Ewart plant, has been appointed general manager of this plant to succeed Mr. Beecherer in this capacity. Mr. Whinrey joined Link-Belt at the Dodge plant in Indianapolis in 1925 upon graduation from Purdue in mechanical engineering and was asst. general manager of this plant at the time of his transfer to the Ewart plant.

New Hoe Attachment Extends Digging Depth

1105

Koehring Company, Milwaukee, Wis., has just designed a new hoe attachment for the Koehring 304 excavator that increases the machine's digging depth to 19 feet, 9 inches. Other improvements made on the Model 304 provide extra resistance to side sway and extra strength to meet any operating condition for below ground level excavating.

Officially rated as a ¾ yard excavator, the 304's sturdy dipper arm is pivoted at the end of the boom and jackknifes to dig a vertical backwall. Position of the counter shaft in line with boom foot mounting provides another advantage. It eliminates dipper drift when the boom is raised. Use of double digging lines to the dipper eliminates reverse cable bends and results in savings due to longer cable life.

Hooker Elects Klaussen Exec. V.P.

Hooker Electrochemical Co., Niagara Falls, N. Y., has announced the election of Bjarne Klaussen as Executive Vice President.

Mr. Klaussen, a graduate of the University of Oslo, joined the Hooker organization as a research chemist in 1916. He has served in various capacities including head of the fine chemicals department, shift superintendent, office manager, plant superintendent and works manager of the Niagara plant. Since 1947 he has served as vice president in charge of production for all Hooker plants.

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

Plastic Tank For Hydrofluosilicic Acid

1106

B. F. Goodrich Chemical Company, Cleveland, Ohio, has completed the installation of a special rigid plastic tank which holds hydrofluosilicic acid for the purpose of fluoridating the water supply for Avon Lake, Ohio.

Mr. Paul McCampbell, superintendent of the Avon Lake Water Works, stated that construction of the vessel, including gas welding and machining, was done at the sales service laboratory of B. F. Goodrich Chemical Co., at Avon Lake. The tank was donated to the city by the company.

Material for the new tank is Geon 404, a rigid vinyl plastic recently introduced by the company. The container, approximately 16 inches in diameter and 26 inches tall, will hold about 20 gallons of the acid. All nuts, bolts, and studs for the tank are also made of the rigid plastic material. No metal is used.

McCampbell says that he believes that the Avon Lake fluoridation system is one of the first in Ohio. The water works, which pumps 1,700,000 gallons of water per day, will use 1 part of hydrofluosilicic acid to every million parts of water.

Johns-Manville Appoints Hinmon

Johns-Manville Corporation, New York, N.Y., has announced the appointment of Don L. Hinmon as Assistant Manager of the Johns-Manville Transite Pipe Department.

Mr. Hinmon succeeds E. A. Phoenix who was recently appointed to the new post of Manager of Market Surveys.

Beginning his career with J-M as a Sales Representative for the company's Building Products Division in 1936, Mr. Hinmon was assigned to a general sales territory in 1941 serving the oil industry. On his return in 1945 from serving with the U.S. Army, Mr. Hinmon was appointed Transite Pipe Staff Manager for the Los Angeles Industrial Products Division. In 1948 he took the post of Manager of the Aviation Industry Section of the Special Industries Department with headquarters in New York City.

A-C Elects Five New Officers

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., in a statement by W. A. Roberts, President, has announced the election of five new officers and the advancement of three others.

Four new vice presidents were elected. W. G. Scholl, general sales manager of the tractor division, was named vice president in charge of sales for the tractor division, and C. W. Schweers, director of sales in the general machinery division, was named vice president in charge of

1. What ?? live in the mountains?
2. What ?? dig through the mountains?
HILL DO NOT COAST
3. What ?? travel over the mountains?
4. What ?? make molehills of mountainous problems in water-treating?
ANSWER: %PROPORTION ??%
%Proportioneers% Heavy Duty Duplex Chem-O-Feeder "smooths out" the roughest water treating problems. For hypochlorination, you can't beat it. For feeding polyphosphates, coagulants, fluorides, slurries, it's tops. And for accuracy and day-by-day dependability, the Chem-O-Feeder is in a class by itself.
We welcome the opportunity to demonstrate what the Chem-O-Feeder can do for you. Mail coupon or write for complete details.
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Please send Bulletin SAN-7
Name
Company
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City State
Answers: 1. Mountaineers 2. Engineers 3. Reindeer(s)
4. % PROPORTIONEERS, INC. %

sales for the general machinery division.

J. F. Roberts, director of engineering in the general machinery division, was named vice president in charge of engineering for that division, and W. A. Yost, manager of the mechanical power department, was named a vice president of the general machinery division.

G. F. Langenohl, assistant treasurer, was elected to the position of treasurer and appointed asistant secretary. N. D. Johnson, asistant secretary, will continue to serve in that capacity and assume additional responsibilities as assistant treasurer.

Two new assistant comptrollers were also named. They are E. J. Dietrich, assistant to the comptroller, and T. D. Lyons, works comptroller.

Executive Elections at American Cyanamid

The American Cyanamid Company, New York, N.Y., announced the election to new posts of several American Cyanamid executives.

Mr. E. D. Powers, Vice President in charge of Production, was elected to the Board of Directors. He succeeds Mr. H. P. Eastman who retired August 31st.

Mr. A. J. Campbell, General Manager of the Industrial Chemicals Division, and Mr. Howard Huston, formerly Assistant to the President, were elected vice presidents. Mr. L. C. Duncan was elected Assistant to the President.

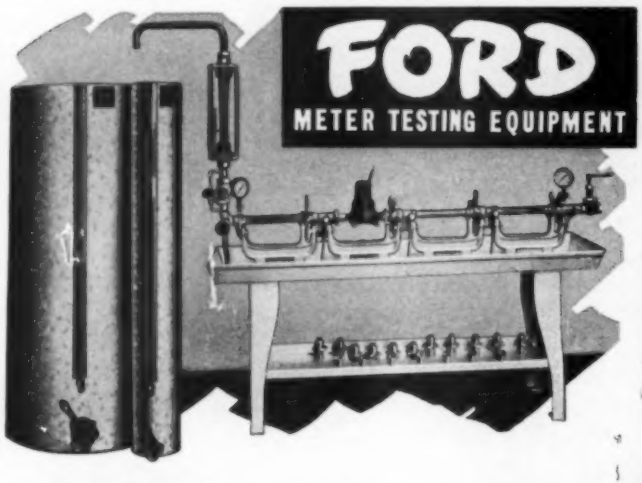
Other Executive changes announced were the election of Mr. J. J. Murray and Mr. G. C. Walker as Assistant Treasurers, and Mr. J. W. King and Mr. W. B. Ward as Assistant Comptrollers.

Double Burette Holder

1107

Laboratory Industries, Inc., Chicago, Ill., has announced that the newest addition to Alumaloy's expanding line of laboratory clamps is a Double Burette Holder of cast aluminum alloy, extremely light in weight (less than half of cast zinc), yet has great tensile strength (45,000 p.s.i.). The 5½ lb. easy to clean, white porcelain base permits greater color discriminations when making titrations. Aluminum support rod is corro-sist treated and the white porcelain base is impervious to practically all reagents.

Independently operated holding arms of special design provide slip-free support of burettes, yet only a slight pressure of thumb and forefinger releases burette instantly. Holder does not obscure graduation lines or numbers of the meniscus level on burettes. Accommodates any size burette from micro to 100ml capacity.



FLEXIBLE . . . *for any size shop*

Ford testing equipment is completely flexible in that it offers utmost economy of testing in any size shop.

FREE . . . .
Complete Ford catalog No. 50 of time and money saving meter equipment

Whether you test meters one at a time or in batteries of 10 or more, Ford provides complete accuracy, fast changing and easy visibility. Ford eliminates scales, weights and percentage beams and guess work.

Just tell us about your testing shop and we show you how to save time and money. No obligation, of course.

THE FORD METER BOX COMPANY, INC.

FOR BETTER WATER SERVICES FORD

Wabash, Indiana

Wilson Consultant On Worthington's West Coast Sales

Worthington Pump and Machinery Corp., Harrison, N.J., has announced the appointment of Charles Ebem Wilson, sales vice president of the Corporation, as West Coast consultant on sales problems.

Mr. Wilson has retired from his position as president of the Worthington-Gamon Meter Corporation, and additional activities in corporation affairs, but will continue in a consulting capacity on sales problems at Worthington's offices in Los Angeles, San Francisco, Seattle and

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Salt Lake City. In addition he will continue on the Board of Directors of Wintroath Pumps, Inc., a wholly-owned subsidiary, whose main offices are at Alhambra, Calif.

A Worthington veteran of 59 years service, Wilson started as an office boy in the Corporation's office in 1892. He soon became a sales representative and in 1905 he was named manager of the Chicago sales territory. He was transferred to the export division of Worthington's New York office as Assistant General Sales Manager in 1918. He later served as G.S.M. from 1923 to 1932. In 1932 he was elected a Vice President, serving from 1934 through 1940 at Los Angeles and recently in the New York and Harrison Offices.

Hoist-Binder

1108

Coffing Hoist Co., Danville, Ill., has announced the new Hoist-Binder that works on the ratchet hoist principle. The load binder will take up or slack off a load chain any amount up to a full 20½ inches, or more if a longer chain is used in the binder.

Among the advantages claimed for the ratchet and pawl construction of the Hoist-Binder is: operating simplicity; binding and slacking off is by means of the handle only, with no buttons or levers to push, no locking device to release; handle will not fly up under load; handle may be removed to prevent tampering with either load or the binder; when handle is out load cannot be released.

The Coffing Hoist-Binder weighs only 10 lbs. and will exert a pull of 3,000 lbs.

Private Sewer Service

National Power Rodding Corp., Chicago, Ill., has developed a completely mechanized mobile unit for sewer maintenance cleaning and for restoring clogged lines.

The unit, with complete operating controls built into an enclosed heavy duty truck, backs up to a manhole or line opening and the entire equipment is ready for immediate action and is capable of reboring up to 1000 feet of pipe in each direction.

The power driven rod is in one continuous piece, fed from a giant reel. This rod is directed through a guard tube into the pipe. The proper size cleaning head is attached to the rod and is motor driven with a boring, spinning action, cutting away tree roots, sediment, even scale.

According to the company, the spinning blade of the cleaning head cannot by-pass obstructions in the line—it can only cut its way through. The blades are specially designed to cut away obstructions with complete protection to the pipe. The boring action is constantly under mechanical control to avoid rod kinking, snap-back, etc.,

HOW TO BUY A VALVE

When you buy a valve, you buy pipe-line control—which encompasses valve design, construction, operation, first cost and maintenance. Purchase-price alone is not the determining factor. Price is relative. A high quality valve having longer life and giving better pipe-line control always is lowest in final cost.

M & H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

DEPENDABLE SERVICE— YEAR AFTER YEAR!

Field reports establish the fact that M & H Valves are correctly designed, dependable in operation, with a record of long life and freedom from repair. Engineers recommend M & H Valves on basis of low cost per year of service. Sizes 2 to 30 inch, inclusive, with all standard end connections, including Mechanical Joint.

COMPLETE INFORMATION ON REQUEST

M&H PRODUCTS Everywhere

common to light equipment. An automatic fluid clutch cushions any shock of contact with an immovable object such as a defective tile—location of defect is registered on the machine to eliminate costly digging to locate the defect.

Replacement Bucket Teeth For Trenchers

1109

Parsons Company, Newton, Iowa, has announced the development of Tap-In bucket teeth as standard equipment of all Trenchliners. Principal feature of the newly designed, self-locking tooth is the "easy-in, easy-out" time saving replacement involved.

Tap-In teeth eliminate the need for bolting or crimping edges to hold teeth in position. A precision fit taper locks the tooth firmly in place either on buckets of sidecutter bars. Sturdy tooth holders are integrally cast with the bucket lip for positive tooth support. By welding adapters to the buckets, Trenchliners of any age can be converted to use Tap-In teeth.

Made of top grade alloy steel and heat treated, Tap-In teeth are designed with added clearance for maximum wear before replacement becomes necessary. In addition, Tap-In teeth need not be reversed. The tooth is designed to retain a sharp point by constant use until worn down to clearance.

Lunger Elected V. P. Of A.C.F.

American Car and Foundry Co., New York, N.Y., has announced the election of Wilber E. Lunger as vice president. Mr. Lunger was formerly assistant vice president in the production department.

Mr. Lunger is a native of Danville, Pa. Educated in New York, he studied engineering and for two years was trained in shop work at ACF's Berwick, Pa., plant. In 1916 he was appointed field inspector in the ACF export division and in 1923 became mechanical engineer at Huntington. He was made general superintendent there in 1937 and district manager in 1946. In November 1949 Mr. Lunger was transferred to New York as assistant vice president.

Hagan Corp. Opens Three Sub-Offices

Hagan Corporation, Pittsburgh, Pa., has announced the opening of three sub-offices in the recently established Chicago district office. The offices also serve Hall Laboratories, Inc., Calgon, Inc., and The Buromin Company, subsidiaries of Hagan Corporation.

Art Soderberg is in charge of the sub-office at Rockford, Ill., covering the northern half of Illinois and Iowa and portions of Wisconsin.

Wilf Chapman is in charge at the Peoria sub-office, serving southern Illinois and Iowa.

Otto Lessa will direct the Indianapolis office, covering portions of Indiana.

"Speedi-Prime" Jet Pump

1110

Jacuzzi Bros., Inc., Richmond, Calif., has developed a highly efficient horizontal jet pump to meet pumping conditions of both deep

St. Louis Turbidimeter

For measuring turbidity of water. Consists of cast aluminum housing, adjustable lamp . . . two vertical walls for holding two Nessler tubes.

This apparatus comes ready to plug into 115 volt line, comes fully equipped for normal operation.

WRITE:

Phipps & Bird, Inc.

P. O. Box 2V Richmond 5, Va.

THE LEOPOLD GLAZED FIRE CLAY TILE FILTER BOTTOM

Check These Features!

• Low loss of head • Adaptable to any rectangular unit • Practically non-absorbent • Resists acid, alkali solutions • Long life • Equal filtration, distribution • Proved superiority.

Write for details!

F. B. LEOPOLD CO. INC.

2413 W. Carson St., Pittsburgh 4, Pa.

INSURE YOUR FILTER

AT NO COST

by using our

FILTER SAND and GRAVEL

FOR WATER AND SEWAGE PLANTS

Close attention to detail by experienced men and new modern equipment insure both the quality and prompt shipment of all orders. Our method of shipping in bulk prevents mixing of sizes in transit.

SHIPMENT IN BAGS WHEN PREFERRED

Try us on your next order.

•

NORTHERN GRAVEL COMPANY

P. O. Box No. 307, Muscatine, Iowa

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

and shallow wells. This pump, named the "Speedi-Prime" because of its rapid self-priming features, is a basic pump, which may be installed with the injector at the pump base above the ground surface for lifts not greater than 25 feet. For depth up to 120 feet, the injector may be installed in the well, using the same basic pump.

The Jacuzzi Speedi-Prime may be installed as a shallow well water system and later converted to a deep well unit. This conversion factor is very important in many areas where the water table is lowering and deep well pumping is anticipated in the future.

The Speedi-Prime is equipped with a mechanical type shaft seal which is leakproof and requires no adjustment. This mechanical seal is of the cartridge type which is easily replaced in the field with no loss of water service or pumping time.

Chain Belt Appoints Cate Equip. Co.

Chain Belt Company, Milwaukee, Wis., has announced the appointment of the Cate Equipment Company as its new District Sales Office in the Salt Lake City Area.

For the past eighteen months Cate Equipment Co., has served as a distributor for Rex and Baldwin-Rex Chains and Sprockets, Rex Belt Conveyor Idlers and power transmission equipment. As a District Sales Office, it will continue to maintain its distributor status and carry stocks of these items for prompt local service.

Located at 49 East Ninth South, in Salt Lake City, the Cate Company also maintains stock at Price, Utah, under the supervision of Mr. Tom McKean.

Wrapped Joints for Resin-Base Pipe

Electro Chemical Engineering & Mfg. Co., Emmanus, Pa., has announced the development of a new type wrapped joint for Haveg and other resin-base pipe, known as the Duro-Joint. The Duro-Joint is composed of a spiral wrapping of glass cloth, Lecite acid and alkali-proof furan resin cement. By using a special technique, it is claimed to be equal in strength and chemical resistance to the pipe itself. The Duro-Joint replaces, in many instances, the flange type joint which is subject to corrosion, and also may be used to repair broken pipe.

Nordstorm Appoints Altorfer, Ch. Engr.

Rockwell Manufacturing Co., Nordstrom Valve Division, Oakland, California, has appointed Hans A. Altorfer Chief Engineer.

Mr. Altorfer is a graduate of the Winterthur Institute of Technology in Switzerland where he received his engineering degree in 1928.

Before joining the Company, Mr. Altorfer spent five years as a designer of machine tools. He then joined the Terry Steam Turbine Company in Hartford, Conn., where he was employed as a mechanical engineer in charge of stress and thermodynamic calculations. He later worked as Supervisor of the Turbo-Power Development Dept., of Allis-Chalmers Mfg. Co., where he was principally engaged in the design and development of steam and gas turbines.

Bowen Appointed By Robinson Clay Prod.

Robinson Clay Products Company, Akron, Ohio, has announced the appointment of John R. Bowen, Jr., as Production Superintendent, Vitrified Products Division.

GREATER SAVINGS on Water and Sewage Plant Installations ASSURED

MUNICIPAL SERVICE COMPANY

Contractors!

Municipal Service Company specialists can relieve you of complicated technical details involved in the mechanical portion of your project. Our experience is your assurance of a successful plant installation. Write or wire today for details.

You're sure of greater savings when you contract with Municipal Service Company to furnish and install mechanical equipment and piping for your new municipal sewage or water plant. Municipal Service Company is a specialized organization of experienced engineers and skilled craftsman operating on a nation-wide basis.

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MANUFACTURE AND INSTALLATION OF MECHANICAL EQUIPMENT FOR WATER AND SEWAGE PLANTS

Dept. M4—908 Grand Ave., Kansas City, Mo.
Chicago office: 205 West Wacker Drive

Bowen, who will supervise production in Robinson's five vitrified products plants—located in Mogadore, Parral, and Midvale, Ohio, Pottstown and Clearfield, Pa.,—succeeds the late William D. Gilson, who died recently after 43 years of continuous service with Robinson.

For the past three years, Bowen has served as Robinson's Assistant Production Superintendent in the Vitrified Products Division. He has played an important part in the mechanization and modernization of the company's plants and in boosting production to high levels during the return to normal operations following the war.

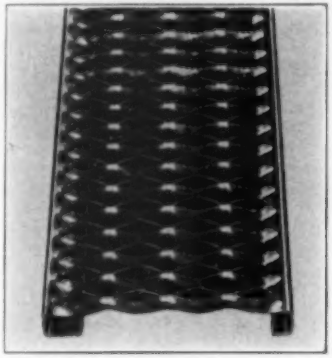
Pipe Mending Cement

1112

Lake Chemical Co., Chicago, Ill., has developed a new, versatile pipe mending cement that forms a positive seal for water, gas, acids and brine.

Called Plumber "Krak-Stik," this new cement can be applied to pipes while the water is flowing through the crack. No heating of pipe surface or stick is necessary. "Krak-Stik" is recommended for split soil pipes, waste lines, sand holes, cracks, pinholes, and gaskets.

A fast acting seal that contracts or expands with the surface, it is reported to work equally well on metal, ceramic or plastic surfaces, and makes an excellent caulking compound.



Grip-Strut Grating

1113

Globe Company, Chicago, Ill., has announced the production of a new development — Grip-Strut Grating, for use wherever a non-skid grating surface is required.

The grating appears as a diamond shaped pattern in which the percentage of open area is in excess of 75% of the total recticulated surface. The struts or vertical members are joined by integral saddles to create lateral struts of great strength. The material used for the manufacture is sheet steel or aluminum of gauges ranging from 12 to 16.

Metal for forming into longitudinal channels, step risers, step nosing or mouldings is integral with the grated surface, eliminating the need and cost of welding in many applications.

American Cyanamid Consolidates Offices

American Cyanamid Company, New York, N.Y., has announced that it has consolidated its several office and warehouse locations in Los Angeles, Calif., into one newly-constructed building at 2300 S. Eastern Avenue.

The move is the fourth of its kind undertaken by the company as part of a nation-wide program calling for similar consolidations in other major cities of the United States and Canada. The program is designed to improve sales and distribution services to customers and to lower administrative costs by bringing under one staff, under one roof, the various

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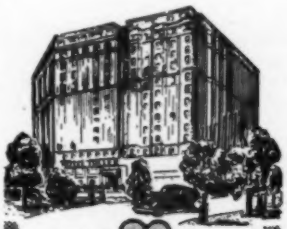

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First thing to do in Detroit is check in at Hotel Tuller! You'll enjoy every minute. Newly modernized. Beautifully decorated. Within walking distance of all downtown stores, theatres and business activities . . . yet, you enjoy the evergreen atmosphere of Grand Circus Park . . . The Tuller Coffee Shop or Cafeteria for excellent food modestly priced.
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800 ROOMS from $3
Harry E. Poehen, Gen. Mgr.
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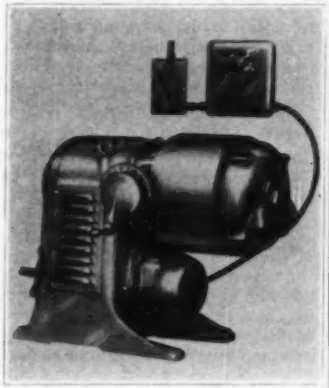
functions performed at numerous locations in those cities.

The building is a 64,000 square foot, one story structure containing 44,000 square feet of warehouse space and 20,000 square feet of offices. It is air conditioned in office, laboratory and certain storage areas and has special refrigeration equipment for pharmaceuticals, antibiotics and biologicals.



ICB Brake Developed For Varidrive Motors

1114

U. S. Electrical Motors, Los Angeles, Calif., has announced that fast, controlled braking of U. S. Varidrive Motors is now possible through the use of a new brake development. The brake used, a Warner type ICB, is mounted directly on the variable speed shaft, eliminating transmission of the braking action through the belt. Ideal for inching or jogging, the ICB offers instant, shockless operation without noise and produces a constantly increasing torque during stopping.

Containing few parts, the ICB has a mechanical movement of only 1/16 of an inch. Unlike the solenoid type brake, its frictional force is controlled directly by the magnetic action of the brake. Adjusted with accuracy, the braking torque, once set, is permanent. For installations requiring diversified braking torques, adjustment is easily made through a knob-controlled rheostat. Designed to dissipate a high rate of heat, the ICB insures stability of operation with long, safe and trouble-free service.

Rust Starts Valley Creek Sewage Plant

Rust Engineering Co., Pittsburgh, Pa., has announced that it has commenced work on a new 15,000,000

CEMENT GUN COMPANY PRE-STRESSES AND RESTORES *EXISTING* WATER TANK

The progress picture above shows a stage of our repair work on a concrete water tank in New England. This tank was completely lined with reinforced "GUNITE" to stop seepage which had caused serious disintegration to the exterior of the tank. The entire outside of the tank was subsequently chipped and existing hoop rods exposed.

To strengthen the tank, wedges were driven behind the rods to take up the slack. This placed the rods in tension and the concrete in direct compression. Wire mesh was then attached to the reinforcing rods and the entire tank treated with two inch mesh reinforced "GUNITE."

The use of "GUNITE" for repair and construction of reservoirs, bridges, buildings, etc., is illustrated and described in Bulletin C 2400. We will gladly send a copy at your request. On your letterhead please.

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"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN PENNA U.S.A.
MANUFACTURERS OF THE CEMENT GUN

WHAT'S NEW about the MASTER SEWAGE & WATER CONTROLS?

THERE IS NOTHING NEW that isn't used in thousands of control applications. Relays, transformers, gauges, timing motors and magnets make up the MASTER controls.

We use only the best standard parts.

JUST WHAT IS NEW ABOUT THE MASTER CONTROLS?

The combination of sound engineering, standard parts and 27 years of experience in the design and manufacture of automatic sewage and water pump controls.

The MASTER controls are designed for—
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Write for MASTER control catalog No. 1050

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IF accuracy in Main-Line Metering means anything to you—

IF ease of installation and maintenance are considerations—

IF negligible pressure lost through the meter is desirable—

IF cost is a factor—YOU NEED

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Bulletin 311 comes at your request

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Boston 8.....6 Beacon Street
Seattle 1.....1932 First Avenue
Dallas 1.....726 Reserve Loan Life Bldg.
Atlanta 3.....66 Luckie St. N. W.

gal. per day sewage treatment plant for Jefferson County, Ala. Cost of the project is estimated at $879,000.

The new installation, known as the Valley Creek Sewage Treatment Plant, is the first unit of proposed additional treatment facilities authorized by Jefferson County voters. The work will be completed in late summer of 1952, according to a Rust official.

Literature & Catalogs

Large Pumps and Motors

1115

Electric Machinery Mfg. Co., Minneapolis, Minn., in their latest issue of **E-M Synchronizer,** a quarterly publication, deals with large pumps and the application of a-c motors to them.

In an illustrated lead article by George R. Thompson, City Engineer for the City of Detroit, Michigan, the new Detroit storm water pumping project is discussed. Other articles cover applications of large a-c motors to centrifugal pumps, cooling water pumping in the petroleum industry, "power house" insulation treatment, and the use of the variable speed Magnetic Drive on pumping applications.

This 2-color, 24-page booklet, fully illustrated throughout, contains much helpful engineering information, charts and diagrams, plus photographs of many of the pumping installations in the country.

Charts Tell a Story

1116

Wallace & Tiernan, Newark, New Jersey, has just published a booklet entitled **"Charts Tell A Story".**

The booklet points out, in a very interesting fashion, the story of how residual chlorine recorder charts have been used to solve problems arising from various sources and uses of water.

The chart case histories cover: a water plant adding carbon in the settling basin; a large indoor swimming pool; a plant getting water from three sources; a power plant; an industrial plant; and at a plant using super-chlorination and dechlorination with SO_2.

The problem, what was done, and the results of each individual case are discussed. Two pages showing W&T Residual Recording equipment complete the booklet.

Liquid Level Controls

1117

Charles F. Warrick Co., Detroit, Mich., has published a catalog on **Floatless Liquid Level Controls, Electrode Type.**

The 32-page catalog discusses the principle of operation of the electrode type floatless liquid level controls along with Standard Control Types; Standard Control Enclosures; Alarm and Signal Combinations; Duplex Pump Alternator Controls; Steam Generator Controls; Special Controls and Panels; Electrode Fittings and Electrodes.

Amply illustrated with photographs and diagrams of each piece of equipment throughout, the catalog also contains 4 pages of application diagrams.

Safety Booklets

1118

National Safety Council, Chicago, Ill., has made available four new booklets on safety, designed for distribution by plant foremen or as payroll enclosures. The booklets cover safety in the plant, at home and on the highway. Humorous cartoons and light treatment in the text sugarcoat the "message."

a SEAL of CONFIDENCE

Tegul MINERALEAD

The original and most widely used plasticized sulfur jointing material, for joining bell and spigot cast iron pipe. Economical—High Quality.

HYDRORINGS

A precast rubber packing for caulking all size bell and spigot cast iron pipe.

Atlas
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BOND-O Homogenized
is a bag of perfect jointing compound

BOND-O's exclusive machine blending process brings you the *one* flawless self-caulking jointing compound. The finest basic materials obtainable are so thoroughly blended by the BOND-O process—that you are assured of absolute uniformity of performance from every bag you buy.

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ROTO-TROL

RS-3
Sump Control
PRESSURE TYPE

Operates with equal success in wet wells containing either clear water or raw sewage. Used only for pumping out of a wet well.

No moving parts in the wet well. No floats to bind, no parts to lose their conductivity, nothing that will plug rapidly, due to building up of sludge. The standard *RS-3* controls one to six pumps discharging from the same wet well. Voltages of 110 to 440, A.C. *RS-3* can be mounted anywhere on wall or switchboard.

Write for performance and engineering data
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"Aren't People Funny?" pinpoints 12 unsafe attitudes — the "dirty dozen" human foibles that are hidden causes of many accidents.

"K.O. Dirt and Disorder" points out why it is better, easier and safer to work in a clean and orderly place.

In **"Cry Whoa!"** Shakespeare takes the wheel to help reduce off-the-job motor vehicle accidents, which account for the greatest share of off-the-job injuries and deaths.

"Safety 'Round the Clock" deals with home safety 24 hours a day, with eight pages of good medicine for the family.

"Packaged Electric Power"

1119

General Electric Company, Schenectady, New York, has available a new 24-page bulletin on **Packaged Electric Power** for industry.

Designated as bulletin GEA-5600, the publication outlines methods of obtaining electric power equipment for quick expansion at low cost and with a minimum of critical materials.

The "package," as explained with 52 photographs and diagrams, is to develop a safer, more flexible, more dependable, more economical and more efficient electrical system. The units, comprised of standardized components, eliminate the need for individually-engineered assembly of piecemeal components. Each package is a complete, factory-assembled unit designed for a specific job and ready for operation the moment it is delivered.

This new publication also offers a list of 31 other G-E bulletins giving full information on available equipment for industrial power expansion.

Ultra-Delonizer

1120

Elgin Softener Corporation, Elgin, Ill., has just published a 6-page bulletin on the **Elgin Ultra DeIonizer.**

It describes single tank deionizers of mixed-bed, monoflo design which gives up to 44 percent more capacity and produces water of highest known chemical purity, free from all ionizable impurities including carbon dioxide and silica.

The bulletin discusses how the deionizer can replace distillation or evaporation processes for as little as 1% to 10% of the cost; and, that the double-check design prevents loss of valuable ion-exchange resins.

Photographs and drawings of the Ultra Deionizer, along with engineering and technical data covering range of sizes, are also included in the bulletin.

Squirrel-Cage Induction Motors

1121

Allis-Chalmers, Milwaukee, Wis., has just released a bulletin describing the construction features of **Large End-Shield Bearing Squirrel-Cage Induction Motors.**

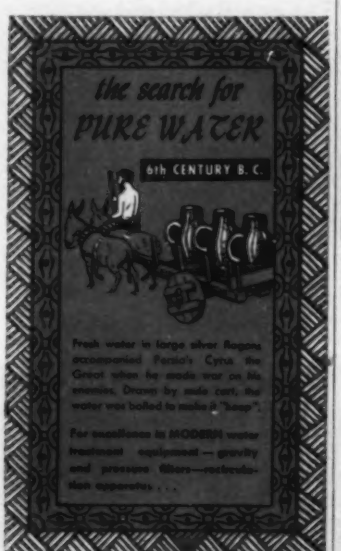
According to the bulletin, construction features of these motors include welded stator yoke, long-life stator winding, capsule-type housings, split sleeve bearings, air-gap access holes, silver-brazed cage, protecting end shields, large discharge openings, and inherently drip-proof design.

The bulletin points out that the motors can be had with special electrical modifications to suit application requirements. Although sleeve bearings are standard, motors may be obtained with capsule-type, anti-friction bearings whenever the speed and application are suitable.

Fusion Welding Of Nickel & Nickel Alloys

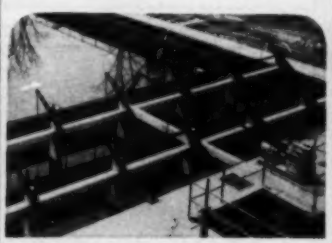
1122

The International Nickel Company, Inc., New York, N.Y., has just



MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

ROBERTS FILTER MFG. CO.
607 Columbia Ave.
Darby, Pa.



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is now specified by water works engineers

1. Eliminates troublesome underwater bearings.
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3. All bearings accessible for inspection and lubrication.
4. Produces quick responsive floc formation.
5. Longer filter runs.
6. A saving in alum.

Having no underwater bearings, Walking Beam Floculation equipment has been in continuous day and night operation for over 5 years. No time out for repairs.

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MAIN SALES OFFICE 50 CHURCH ST., N. Y. C.

General offices and works W. Medford Sta., Boston, Mass.

published a new 44-page booklet on the **Fusion Welding of Nickel and High Nickel Alloys.** It contains more than 30 tables and almost 50 drawings and photographic illustrations.

A complete technical treatise on the subject, it covers various forms of electric arc welding as well as gas welding. There are over 20 chapters and sections covering, in addition to detailed welding instructions, such information of importance to engineers as the boiler code of the American Society of Mechanical Engineers, pickling, testing and inspection safety methods and associated topics.

Welded Steel Pipe

1123

Spang-Chalfant Division of the National Supply Company, Pittsburgh, Pa., announces a new 32-page bulletin covering its **Spang "CW" steel pipe** in all standard sizes from ⅛ inch to 4 inches, with tables of dimensions, weights, test pressures, threading data, and bundling schedules.

Modern fabrication methods, constant development and application of closer controls on the mechanized fabricating processes are emphasized in the bulletin as the means of producing pipe with qualities beyond standard specifications.

Profusely and attractively illustrated in color, the booklet presents a picture story of the steps of manufacture from skelp through the heating furnace, the continuous welding process, and numerous finishing operations by which Spang "CW" steel pipe is made.

Low-Pressure Coupling

1124

Naylor Pipe Company, Chicago, Ill., has just published a new folder illustrating and describing the **Low-Pressure Wedge-Lock Coupling.**

Designed for connecting light weight pipe in ventilating and similar low-pressure service, this one-piece positive type coupling features speed and simplicity of installation, it is stated.

Included in data are complete specifications on pipe sizes from 8 to 30 inches in diameter.

Diesel Engines

1125

Worthington Pump and Machinery Corp., Harrison, N.J., has just published an 18 page bulletin on a new line of **DR Diesel Engines.**

The bulletin describes and pictures the four-cycle, direct injection, totally enclosed engines with photographs, cut-away line drawings and specifications.

Also described are the supercharged SDR engine, the DRGO Dual Fuel Diesel and the SDRGO Supercharged Dual Fuel Diesel.

Belt Conveyor Idlers

1126

Chain Belt Company, Milwaukee, Wis., has announced the availability of its new Bulletin No. 51-81 on **Rex Belt Conveyor Idlers and Machinery.**

The book contains information on all of the latest designs and developments of this equipment. A large "cross-section" of steel and the cast gray iron idler rolls is shown. There are two pages of general engineering information to help in designing and specifying belt idler equipment.

The very latest information on the new Rex Style No. 33RA Return Belt Training (Self-Aligning) Idler is given, together with material on the newly developed Styles No. 40 and 46 steep-angle Troughed Belt Idlers and Style No. 33G and 33WC steep-angle Troughed Belt Training (Self-Aligning) Idlers. Latest data on lubrication material and techniques is included.

"Since 1885"

Sewage and Garbage Shredders

Detailed Specifications and suggested Installation Drawings furnished

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FOR SALE

1—24 ton Nichols-Herreshoff Multiple Hearth Burner, used only a few months.

1—30 ton Trash Burner.

For further information, contact Mr. J. R. Palmer, Director of Public Works, City Hall, Rock Island.

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PORTABLE

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FOR STANDS & UNDERGROUND GATES—MOTOR TRUCK MOUNTED

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The Pioneer Self Caulking Material for C. I. Pipe

50 YEARS PROVE IT!

• Tested and used by engineers, water works men and contractors for more than 50 years. LEADITE has proved its dependability under most every condition of water main construction . . . proved that it makes a good tight lasting joint that improves with age.

THE LEADITE COMPANY

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No Caulking

6 Reasons why

PALMER SURFACE WASH SYSTEMS

are specified by water works engineers

1. Prevent Sand Beds From Cracking.
2. Eliminate Mud Balls.
3. Save Wash Water.
4. Lengthen Filter Runs.
5. Higher Rates of Filtration.
6. Better Tasting Water.

Having no underwater bearings, Walking Beam Flocculation equipment has been in continuous day and night operation for over 5 years. No time out for repairs.

Write today for Bulletin 451 and a list of water purification plants that have gone modern.

STUART CORPORATION

516 N. CHARLES ST., BALTIMORE 1, MD.

A detailed description of zipper bunker seals is included plus data on belt conveyor trippers. A section of the book contains useful information on correct maintenance proceedure.

Fittings & Flange Dimension Data Card

1127

Taylor Forge & Pipe Works, Chicago, Ill., has just issued an 8½ x 11 inch card on **Seamless Welding Fittings** that gives dimensions on welding fittings and flanges. This card condenses information previously available only by searching through many catalog pages.

One side covers the broad Weldell line of Taylor Forge welding fittings and shows the wall thickness and essential dimensions for all types of fittings for every nominal pipe size from ½ through 30 inches.

The other side covers the complete line of forged steel flanges including the essential dimensions and bolting data for all types of flanges, in all weights, for nominal pipe sizes from ½ through 24 inches.

Varnished on both sides, to withstand prolonged use, useful information for piping engineers is also included on the card.

Hydraulic Pullers and Jacks

1128

Templeton, Kenly and Co., Chicago, Ill., has just published a new 2-color, 8-page bulletin, **Hydraulic 51** which discusses labor-saving applications of hydraulic pullers and jacks.

The bulletin also introduces Simplex Re-Mo-Trol Hydraulic Pumps and Remote-Controlled Rams. It illustrates how these units simplify rigging requirements and improve safety in numerous pulling, pushing and lifting operations, by means of "Center-Hole" tubular ram construction.

Complete specifications of Re-Mo-Trol units and all other Simplex Hydraulic Jacks and Jennies are included.

Weatherproof Motor Starters

1129

Arrow-Hart & Hegeman Electric Co., Hartford, Conn., has just published an eight-page folder illustrating and describing a new line of **Arrow-Hart "Explo-Safe" and Weatherproof Motor Controls** for Hazardous locations.

The folder gives complete information including dimensions,

EXPAND with...

EDDY HYDRANTS

Mechanical Joint Connection Cuts Installation Time...

Since 1849 EDDY For Long Service

Eddy Hydrants open smoothly *with* the pressure ... have large, clear waterways to insure plenty of water ... close without water hammer. Stem held in place below main valve means no water loss due to bent stem. Positive drip action drains barrel when hydrant is closed — prevents freezing. One man can remove all operating mechanism easily for inspection or repairs. Expand now, to meet any emergency — with Eddy Mechanical Joint Hydrants! Can be installed in any weather, or in a flooded trench. A ratchet wrench is the only tool needed.

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A Subsidiary of James B. Clow & Sons

WATERFORD, NEW YORK

2—New 400 H.P. WESTINGHOUSE MOTORS in original crates. Vertical pump motors. 2200 volt 3 phase 60 cycle 708 RPM. Weatherproof construction including thermoguards. Motors have tapered roller-type anti-friction thrust bearings and are self cooled. Can save you money on these motors.

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USED
CAST IRON BELL & SPIGOT PIPE
10" Class 150
Approximately 20,000 feet available
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2nd and Riverview (X-771)
Kansas City 16, Kansas
THatcher 9243

weights, ratings and wiring diagrams for these magnetic across-the-line starters which the manufacturer claims are smaller and lighter than conventional motor starters. The reduction in size and weight is made possible, according to the folder, by use of Arrow-Hart's patented right angle "RA" mechanism.

Another point brought out in the "Explo-Safe" folder is that these motor starters in NEMA types VII, IX, and IV are approved by Underwriters' Laboratories.

Selection Information for Condensate Return Units

1130

Roy E. Roth Company, Rock Island, Ill., has just published a **Catalog Section 212** which contains an easy-to-use selection table that enables rapid and accurate selection of the correct Roth Vertical Condensate Return Unit to fit specific needs.

Table gives EDR sq. ft., capacity in gpm., receiver capacity in gallons, and range of models according to boiler pressure. Also, this new vertical design unit. particularly intended for installation where return piping is close to floor level, is described in detail.

Unit is supplied as complete assembly ready to install. Complete specifications for pump, receiver, motor, and accessories are included. All installation dimensions are given graphically.

Vertical Turbine-Type Pumps

1131

Ingersoll-Rand Company, Phillipsburg, N. J., has prepared an 8-page catalog which describes the Class APH-APK line of **Vertical, Turbine-Type Pumps.**

These pumps are particularly applicable to bulk liquid transfer, cooling tower, dewatering and similar services where suction is taken from an open source. The catalog states that the pumps are available in single or multi-stage construction, with any desired column length, and range in size from 6 to 30 inches, for capacities to 15,000 gpm and pressures to 250 psi.

Attractively illustrated with photographs and diagrams, the pumps are available with either open, water-lubricated shaft or oil-lubricated, enclosed shaft constructions.

Centrifugal Blowers And Compressors

1132

De Laval Steam Turbine Co., Trenton, N. J., has just published a new 52-page bulletin on **Centrifugal Blowers and Compressors.**

The bulletin contains comprehensive data on three types of De Laval centrifugal blowers and compressors: multistage; single stage, end suction and single stage double suction. Capacities range from 1000 to 150,000 cfm for pressures to 150 psi and above. Special units for higher pressures and for service at operating pressures to 1000 psig are also described.

The information in the bulletin is arranged in four maior sections:

Application data for: Blast furnace and Bessemer Converter blowers; process industry applications; Water gas plants; High pressure natural gas transmission; Gas compressor or booster services; Coal gas producers and coke ovens; and Air for combustion, agitation and supercharging.

Design and Construction: Includes complete descriptive data, cross-sections and detail photographs showing construction and manufacture.

Drives: Steam turbine and motor.

Engineering Data: Curves, formulas and examples for computing compression of gases and pipe friction.

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Stay at the newest, most centrally located hotel in the Motor City, completely fireproof, 750 outside rooms with bath, smart new furnishings, lowest comparable rates, ample parking space—a find for the cost-conscious traveler! ***Dining Rooms Air Conditioned***

The NEW Hotel Detroiter
Woodward at Adelaide, Detroit 1, Michigan
Convention and Touring Groups Invited

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Testimonials such as this from subscribers to WATER & SEWAGE WORKS really tell the story. The man who reads and uses the magazine as an aid in his work knows how much it will benefit other workers in the field.

The great REFERENCE & DATA issue alone is worth more than the yearly subscription rate. In it you will find formulae, charts and illustrations covering information not obtainable in any other one source.

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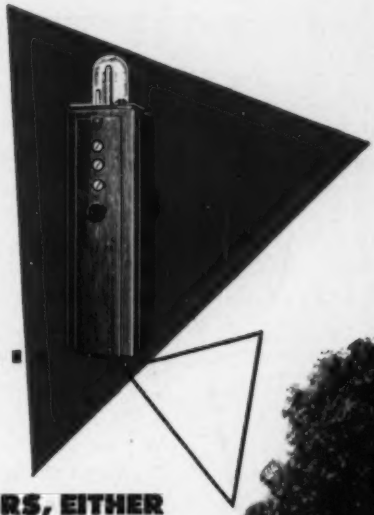

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